

AGRICULTURAL RESEARCH SERVICE

FY 1999 ANNUAL PERFORMANCE REPORT

The Agricultural Research Service (ARS) was established on November 2, 1953, pursuant to authority vested in the Secretary of Agriculture by 5 U.S.C. 301 and Reorganization Plan No. 2 of 1953, and other authorities.

ARS is the principal in-house research agency of the U.S. Department of Agriculture (USDA). Congress first authorized federally supported agricultural research in the Organic Act of 1862, which established what is now USDA. That statute directed the Commissioner of Agriculture "... To acquire and preserve in his Department all information he can obtain by means of books and correspondence, and by practical and scientific experiments..." The scope of USDA's agricultural research programs has been expanded and extended more than 60 times in the 135 years since the Department was created.

The research currently performed by ARS is authorized by the Department of Agriculture Organic Act of 1862 (7 U.S.C. 2201, 2204), Research and Marketing Act of 1946, amended (7 U.S.C. 427, 1621), Food and Agriculture Act of 1977, as amended (7 U.S.C. 1281 note), Food Security Act of 1985 (7 U.S.C. 3101 note), Food, Agriculture, Conservation, and Trade Act of 1990 (7 U.S.C. 1421 note), Federal Agriculture Improvement and Reform Act of 1996 (FAIR Act), and the Agricultural Research, Extension, and Education Reform Act of 1998 (PL. 105-185).

The ARS mission is to conduct research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to: ensure high-quality, safe food, and other agricultural products; assess the nutritional needs of Americans; sustain a competitive agricultural economy; enhance the natural resource base and the environment; and provide economic opportunities for rural citizens, communities, and society as a whole.

Verification, Validation, and Program Evaluation: ARS currently conducts a series of review processes designed to ensure the relevance and quality of its research work and maintain the highest possible standards for its scientists. This process involves customer input to help keep the research focused on the technical needs of the American food and agricultural system. Each of the approximately 1,100 research projects undergoes a thorough merit review before new or renewed activities are begun. All ARS employees, including the scientific workforce, are subject to annual performance reviews, and the senior scientists undergo a rigorous peer review (Research Position Evaluation System--RPES) on a 3- to 5-year cycle. These processes ensure the continuing high quality of the ARS scientific workforce.

ARS is in the process of restructuring the way it organizes and manages its national research programs. As part of this process, ARS has aggregated its 1,100 research projects into 23 national programs managed by multi-disciplinary teams of National Program Leaders (NPLs). The national programs will focus the work of the Agency on achieving the goals defined in the ARS Strategic Plan. In FY 2000, ARS will begin a series of program and program component reviews that will supplement current merit, and RPES reviews to ensure the quality, relevancy, effectiveness, and productivity of the work being done in each national program. The annual performance plans will also serve to keep the work of the Agency focused on achieving the goals established in the ARS Strategic Plan. The aggregate effect of these changes will be a strengthened research program and an accountability system that will measure more effectively the progress made towards established goals and outcomes.

Additional information describing the key external factors affecting the ability of ARS to achieve the goals and objectives described in this report and a description of the Agency's partnerships with other Federal agencies can be found in the introduction to the ARS Annual Performance Plan. The Annual Performance Plan and Report are available on the ARS home page – www.ars.usda.gov.

In January 1998, ARS requested permission from the Office of Management and Budget (OMB) "to describe specific and tangible products, steps, intermediate goals, and/or accomplishments that will demonstrate that the Agency has successfully met each Performance Measure/Goal in a given fiscal

year.” With OMB’s concurrence, the ARS has employed narrative descriptions of intermediate outcomes and indicators of progress instead of numerical metrics as specified in GPRA. The indicators listed in this Annual Performance Report represent intermediate outcomes, significant products or anticipated impacts of the Agency’s work, which will serve to measure progress during FY 1999. The research and technology transfer activities listed in this report are not all inclusive of the Agency’s work. The indicators reflect, but do not adequately capture the broad range of basic research that underpins much of the Agency’s work. Because of the unique nature of research, as recognized by the OMB waiver, ARS accomplishments are described using a nonnumeric narrative approach that may differ from the style and format used by most other USDA Agencies.

Only Federal employees were involved in the preparation of this report.

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GOAL 1: Through Research and Education, Empower the Agricultural System with Knowledge That Will Improve Competitiveness in Domestic Production, Processing, and Marketing.

Analysis of Results: This goal is the focus of much of ARS' research related to production agriculture. Under Goal I, 54 Indicators are aligned under 12 Performance Goals. Because of the unique and dynamic nature of research, several Indicators were added to the Report that did not first appear in the Annual Performance Plan for FY 1999. This was done to ensure that significant accomplishments that were not anticipated last year were reported. While it is not possible to report research accomplishments numerically, the progress projected in all 54 Indicators was completed or substantially completed during FY 1999.

OBJECTIVE 1.1: Strengthen Competitiveness: "Enhance the competitiveness of the United States agriculture and food industry in an increasingly competitive world environment."

STRATEGY 1.1.1: Cost-effective agricultural production systems: Develop new knowledge and integrated technologies for more efficient and economically sustainable agricultural production systems of all sizes.

PERFORMANCE GOAL 1.1.1.1: Demonstrate and transfer to users integrated systems.

Indicators:

During FY 1999, ARS will

identify and implement strategies, and evaluate a system to reduce feed costs for brood cows.

ACCOMPLISHMENTS: ARS scientists in the Nutrition Research Unit, Clay Center, Nebraska, found that the timing of protein supplements changed the pattern of nutrient absorption, but overall protein economy was unchanged when animals were fed cheap low quality forages.

IMPACT/OUTCOME: These results demonstrate how producers can use a program of infrequent supplements for range cows to reduce labor and fuel costs when animals are fed low quality range grasses.

identify and implement strategies, and evaluate a system to economically raise replacement beef heifers.

ACCOMPLISHMENTS: ARS scientists at the Nutrition Research Unit, Clay Center, Nebraska, defined heifer development programs that reduce the costs related to growth and development within acceptable rates of productivity for a wide range of biological types.

IMPACT/OUTCOME: This research has been presented in peer reviewed journals, trade journals, and on radio, and also made available to other scientists working on the development of decision support software. The data has been adapted for management systems which is currently available to producers. The research will have long-term usefulness because the conceptual strategies are connected to biological resources to improve the economic sustainability of the production system.

demonstrate under simulated field conditions the value of somatotrophin as an animal health adjunct.

ACCOMPLISHMENTS: ARS scientists in the Growth Biology Laboratory, Beltsville, Maryland, demonstrated the effects of growth hormones, especially in the long term. The observed difference may be related to the increased production of free radicals in animals treated with growth hormones. The use of intramuscular vitamin E injection neutralized the negative effect of growth hormones presumably by allowing the increased production of free radicals, but limiting their toxic effect on cells.

IMPACT/OUTCOME: This research has shown the interaction of nutrition, hormone, and immune system responses in the presence of disease and that intramuscular vitamin E injection appears to be a practical strategy to limit the impact of disease on animal performance. This information is useful to livestock producers and veterinarians.

publicize research results of a method to enhance conservation of nitrogen and reduce nitrogen losses to the environment.

ACCOMPLISHMENTS: Workshops were held by ARS scientists at Beltsville, Maryland, and Ithaca, New York, with collaborators and stakeholders on nutrient management (nitrogen). Discussions led to the identity of several deficiencies in nutrient management plans and support modules currently in use in the areas of nutrition and manure management.

IMPACT/OUTCOME: Research is ongoing and incomplete.

<p>PERFORMANCE GOAL 1.1.1.2: Demonstrate and transfer to users computer-based simulation models and decision-support systems.</p>
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Indicators:

During FY 1999, ARS will

deliver for on-farm beta testing a second generation simulation-based cotton production decision aid. This new tool will enable cotton producers to make more competitive decisions regarding amounts and timing of fertilizer, water, and defoliant under field conditions that include insect damage. An earlier decision aid of this type was credited with increasing returns up to \$50 per acre.

ACCOMPLISHMENTS: Scientists worked with a validation team to test the new ARS cotton model against field data. The validation team is an intermediate step between the completed software and actual beta testing. The model will be turned over to on-farm testers next season.

IMPACT/OUTCOME: The new cotton model is more robust and simulates cotton growth and production much better than it did at the start of the year. The model will assist cotton farmers in managing their cotton crops, optimizing inputs, increasing profitability, and reducing environmental impacts of their production. This will increase their profit and safeguard water quality.

beta test the decision support system GPFARM on farms in eastern Colorado. This new tool has been developed with input from a group of farmers and ranchers of the region to provide whole farm management assistance.

ACCOMPLISHMENTS: A whole farm decision support system (GPFARM) was developed to provide farmers/ranchers with a tool to quickly evaluate management strategies and options for making decisions in their best financial interest, while protecting the water, soil, and air resources. Version 1.0 of the software was released for whole farm evaluation and testing in cooperation with five farm/ranch operations and project collaborators in NRCS, industry, academia, and other ARS offices. The software has full capabilities in the areas of crop/livestock and environmental simulation, economics, and information accessibility.

IMPACT/OUTCOME: Use of this tool by the agricultural community will significantly alter farm management by allowing farmers and their advisors to use the latest information technology to more effectively cope with market and weather fluctuations, thereby increasing farm productivity.

STRATEGY 1.1.2: Postharvest control of pests: Develop postharvest technologies and processes to meet domestic needs and reduce or overcome nontariff trade and quarantine barriers caused by pests (insects, weeds, pathogens, etc.).

PERFORMANCE GOAL 1.1.2.1: Demonstrate techniques to control or eliminate postharvest insects and diseases, and increase market quality and product longevity.

Indicators:

During FY 1999, ARS will

begin studies designed to determine the mechanisms involved in natural insect pest resistance present in certain corn varieties.

ACCOMPLISHMENTS: ARS scientists determined the chemical and physical properties of 72 commercial corn hybrids, and the population development of maize weevils on these same hybrids. Approximately half of them showed significant insect resistance. Researchers will next try to correlate insect population development with the chemical and physical properties of the corn hybrids.

IMPACT/OUTCOME: Correlating insect population development with chemical and physical properties of corn kernels will enable resistance prediction of other corn hybrids to maize weevils.

continue with the development of chitinase and other potential biopesticides and examine their use in combination with other available control strategies. Specific industries have incorporated these genes into field crops and are testing their effectiveness.

ACCOMPLISHMENTS: ARS scientists, in collaboration with ProdiGene, Inc., evaluated transgenic avidin maize for insect resistance. Expression of egg white avidin as a recombinant protein in corn resulted in kernels that have resistance to most stored product insects. It also generated mutant forms of insect chitinases in which one of the amino acid residues was substituted for other amino acids. The enzymatic and pesticidal properties of the modified chitinases were determined to be less efficacious than the native enzyme. Other types of mutated chitinases were prepared for future evaluation.

IMPACT/OUTCOME: The accomplishments describe a very useful biotechnology method for controlling stored product insect pests and strengthens the basis for developing transgenic grains with resistance to

insects so that the storability of these grains will be enhanced. Transgenic avidin maize is one of a very few new uses of transgenic plant biotechnology for insect pest management. It has exciting possibilities for both pre- and postharvest pest control.

continue screening wheat germplasms for resistance to the Hessian fly, a major insect pest in the region where Hard Red Winter wheat is grown. The discovery of several different resistance genes and their transfer to commercial wheat varieties could save producers millions of dollars in lost productivity. Screening data on public and private varieties will give Extension Specialists the information needed to assist producers with varietal selection.

ACCOMPLISHMENTS: Researchers tested a total of 6,787 different wheat lines for the presence of Hessian fly resistance. They located several new sources of resistance including two accessions of *Triticum boeoticum* from Serbia and a single dominant gene from *T. dicoccum*.

IMPACT/OUTCOME: A breeder seed was prepared from a line, TX93V5722, having high yield potential and resistance to the Hessian fly. This was especially important because of the yield losses associated with the 1996-1997 outbreaks of the Hessian fly in Western Texas. These results will lead to the development and release of new wheat varieties that have greater resistance to the Hessian fly.

discover natural product-based fungicides and fungistatic agents for postharvest treatment of horticultural crops.

ACCOMPLISHMENTS: ARS scientists developed an integrated strategy using natural compounds in combination with heat and a bacterial agent to control postharvest blue mold decay in Gala apples. Natural compounds were used to develop a "bioactive coating," which reduced decay and decreased populations of pathogens. A citrus postharvest decay preventative procedure of washing fruit with sodium bicarbonate was developed that demonstrated the value of calcium incorporation in apples to control decay.

IMPACT/OUTCOME: Postharvest losses due to decay of fruits during storage, shipping, marketing and in consumer homes cause significant financial burdens for both growers and consumers. The developed procedures may help control such losses without the use of chemical fungicides.

ACCOMPLISHMENTS: Antifungal activity against *Colletotrichum spp.* by compounds from aquatic organisms and cyanobacteria are significantly higher than observed for a diverse sampling of terrestrial plant species (12 to 30 percent, as compared to only 1.5 percent for terrestrial plants). An invention disclosure has been filed for one promising compound.

Research funded by the North American Strawberry Growers Association demonstrated that levels of naturally occurring antifungal compounds in anthracnose resistant variety "Sweet Charlie" produces approximately 15 times more antifungal activity than anthracnose susceptible "Chandler." Preliminary evidence indicates that anthracnose resistance in strawberries may depend on the concentration of two constitutive antifungal compounds and the elicitation of a third compound in younger leaves.

IMPACT/OUTCOME: Under a new CRADA, ARS and PhycoGen, Inc., in Portland, Maine, are evaluating zosteric acid, a natural product from eelgrass to control fungi that cause fruit and crown rot of strawberries. Zosteric acid may lead to a nontoxic way to protect strawberries and other crops from fungal diseases.

cooperate with numerous companies and universities in the evaluation of a wide variety of different grain protectants, including testing the effectiveness of encapsulated pesticides, entomopathogenic fungi, heat sterilization of facilities, diatomaceous earth, parasitic insects that attack grain pests, new classes of chemicals with novel modes of action, and development of insect resistant packaging.

ACCOMPLISHMENTS: Researchers continued work in the development of parasitic wasps. Parasitic wasps, commonly called parasitoids, are naturally occurring, beneficial insects that attack and kill grain insect pests. They are a potential tool for controlling pests while grain is being stored and marketed. Since some grain insect pests feed inside the kernel, the parasitoids that attack them also exist inside the kernel as a normal part of their life cycle. It is often impossible to visually determine if kernels contain internal pests or internal parasitoids. Near Infrared Analysis (NIR) was used to scan wheat kernels automatically with 100 percent accuracy to distinguish kernels that contained internal insect pests from those that contained parasitoids that had attacked the insect pests.

In a cooperative research effort with a food manufacturing company, it was determined that certain types of cereals were becoming infested in grocery stores, while other cereals from the same plant were not. Results showed that the problem cereals contained significant quantities of dried apricots and apples which are attractive to a number of insects. Also influencing infestation was the type of package liner. The company had been testing a liner with minute holes which allowed pressure on the inside and outside of the packages to prevent a "pillowing" effect with pressure changes. These minute holes allowed insect pests to determine the contents of the package and provided them with a starting place to invade. The same cereals in packages without holes were much more resistant to insect invasion and remained insect free for approximately eight weeks while the packages with holes became heavily infested after two weeks. Other cereal types containing little or no fruit remained almost free from insect infestation for twelve weeks.

IMPACT/OUTCOME: The NIR technique is rapid and efficient and can be used by companies that mass produce these beneficial insects to sort and characterize large numbers of samples for shipping and subsequent release in biological control programs. The cereal study indicates the importance of odor in developing an effective insect-resistant package.

evaluate milkweed seed meal and pod trash as an alternative nematicide on potato fields in Washington State.

ACCOMPLISHMENTS: The seed meal and pod trash were evaluated and found to be effective in the field.

IMPACT/OUTCOME: Potential exists to replace chemical control agents with these agrimaterials.

PERFORMANCE GOAL 1.1.2.2: Demonstrate technologies to control quarantine pests.
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Indicators:

During FY 1999, ARS will

develop a commodity irradiation quarantine treatment for nonfruit fly pests to expand the kinds and quantities of commodities allowed to be exported from Hawaii to the continental U.S.

ACCOMPLISHMENTS: ARS researchers at the Pacific Basin Agricultural Research Center developed an irradiation commodity treatment for *Cryptophlebia* moths, quarantined pests found in Hawaii but not the Mainland United States, in longan and lychee. They also determined that irradiation doses of 100-300 Gy were sufficient to sterilize mango seed weevil in mangos.

IMPACT/OUTCOME: Shipments of irradiated longans and lychee originating in Hawaii were inspected for *Cryptophlebia* moths, and if they were found, the shipment was denied entry into the Mainland because the irradiation treatment, although effective against fruit flies, was not known to be effective against *Cryptophlebia*. *Cryptophlebia* is a common pest of these commodities and threat of denied entry with expensive consequences for shippers inhibited further opening of the Mainland market to Hawaii-grown

fruit. This research will remove a significant deterrent to shipping these fruit to the Mainland. Research on mango seed weevil may remove the current ban on shipment of Hawaii-grown mangos to the Mainland. This could significantly improve the economics of growing mangos in Hawaii.

develop a new quarantine treatment for codling moths in cherries to replace the methyl bromide treatment currently required by Japan to allow importation of U.S. cherries.

ACCOMPLISHMENTS: ARS scientists completed research on an irradiation, as well as a controlled atmosphere/heat, quarantine treatment for U.S. grown cherries to be exported to Japan at its laboratory in Wapato, Washington.

IMPACT/OUTCOME: Currently 25 percent plus of Washington State and California cherries are exported to Japan, all with a mandatory methyl bromide treatment. The uncertain continued availability of methyl bromide because of concern that it damages the stratospheric ozone layer, gives high priority to the development of alternative quarantine treatments. Development of these alternative treatments form the basis for continued access to the critical Japan market should methyl bromide be banned from use as a quarantine treatment.

develop effective and practical technology to recapture methyl bromide used in quarantine treatments to avoid venting the stratospheric ozone-depleting gas to the atmosphere.

ACCOMPLISHMENTS: ARS scientists, along with collaborators from the private sector, completed development of an effective system for scrubbing methyl bromide from fumigation chambers, greatly reducing the amount of methyl bromide vented to the atmosphere after fumigations with this material. A pilot plant has been installed in Dallas, Texas, to recapture methyl bromide from a commercial fumigation chamber used to fumigate imported commodities where inspection has shown presence of pests of quarantine significance.

IMPACT/OUTCOME: Successful operation of the pilot plant has opened the way for continued use of methyl bromide in locations where emissions of methyl bromide must be curtailed for health or environmental reasons. Use of this technology may ultimately allow continued use of methyl bromide as a quarantine treatment, a use which is currently not listed for phase-out under the Montreal Protocol, but which is under increased scrutiny for regulation in the future.

with Canadian collaborators, examine the practical implications of phosphine-induced corrosion relative to potential equipment failure and develop mitigating measures to allow its use for insect disinfestation of flour mills and other structures presently fumigated with the ozone-depleting fumigant, methyl bromide.

with Canadian collaborators, determine the effect of differing levels of heat, humidity, and carbon dioxide on corrosivity of phosphine gas, a potential fumigant replacement for methyl bromide, on several types of metals.

ACCOMPLISHMENTS: Both indicators were addressed by ARS sponsored research conducted by Canadian scientists that clarified the role of heat, humidity, and type of metal on corrosiveness of phosphine gas used in flour mills and other types of structures containing equipment at high risk of damage from corrosion. Humidity was a particularly significant factor in the development of corrosion for some metals, with relatively lower levels of humidity being worse than high humidity levels -- a finding that is counter-intuitive.

IMPACT/OUTCOME: Regulation of humidity levels in ranges that showed the least tendency to cause corrosion may offer sufficient safety to allow the use of phosphine in food processing facilities. These facilities will be severely impacted by the loss of methyl bromide as a fumigant and there is presently no registered alternative except for phosphine. Because of the importance of this use in the food production

industry, finding a way to use phosphine is a high priority for ARS and the data generated by this research may open its use for some or many current methyl bromide uses.

PERFORMANCE GOAL 1.1.2.3: New and improved diagnostic tests are developed and available.

Indicators:

During FY 1999, ARS will develop procedures to reduce losses due to postharvest decay of stored commodities using improved detection methods to identify contaminated products, and improved chemical and physical treatments to control decay without the use of environmentally-damaging pesticides and fumigants.

ACCOMPLISHMENTS: An improved assay for detection of the late blight fungus in potato tubers was developed. This procedure is based on a DNA-based assay which will detect the fungus at much lower levels than previous assays.

IMPACT/OUTCOME: Low levels of potato late blight in seed potatoes could not be detected with previous assay methods, sometimes resulting in severe disease epidemics later in the season. A more sensitive assay will detect much lower levels of the fungus, and should prevent the planting of diseased material and reduce losses to late blight.

ACCOMPLISHMENTS: Researchers developed an automated system for detection of insects in single wheat kernels. Technology was transferred to Perten Instruments, Springfield, Illinois through a CRADA.

IMPACT/OUTCOME: The commercial system is now available for detection of single kernel quality. This system allows rapid screening of grain entering storage to identify insect infestation problems so that proper control means can be employed. Early detection of insect infestation can reduce or eliminate pesticides needed to control pests. The technology is also finding applications in rapid identification of insect species that transmit infectious diseases. This related research is in cooperation with the Center for Disease Control, and the Kansas State University Entomology Department.

begin a cooperative study with the Communicable Disease Center designed to show that the NIR system attached to the Perten 4100 is also capable of identifying mosquito species.

ACCOMPLISHMENTS: ARS scientists developed rapid nondestructive procedures using NIR spectroscopy for determining the species and age of stored grain insects and mosquitoes.

IMPACT/OUTCOME: Rapid species identification and the age of insects is important for studying population dynamics and implementing proper control mechanisms. In addition, rapid identification of infectious disease vectors is important to prevent or minimize disease outbreaks. This work is the subject of additional cooperative research between the Center for Disease Control, Kansas State University, and several ARS laboratories.

continue the development of acoustical detectors, pheromone traps, and other tools that can detect the presence of insects in stored grain, and grain-handling and food-processing facilities.

ACCOMPLISHMENTS: The in-bin acoustical monitoring system developed for detection of insect pests of wheat stored on farms has been adapted for use by grain elevators by an ARS scientist in Gainesville, Florida, and a Kansas State University engineer. Sensor level amplification and data processing have increased the distance at which insects can be detected by reducing electrical noise problems and allowing continuous monitoring with each sensor. Increased detection distance and continuous monitoring reduces the number of sensors needed to monitor insect populations at grain elevators.

In cooperation with Trece, Inc., and Oklahoma State University, the FLITe TRAK insect detection trap was modified with the addition of a dust resistant cover.

IMPACT/OUTCOME: An automated insect monitoring system can provide elevator managers with a cost effective method of determining when fumigation is needed. Up to date insect monitoring data will enable elevator managers to fumigate only infested grain and do it before insects numbers reach damaging levels and spread to other grain. This technology can reduce the risk of incorrect management decisions, reduce the amount of grain that needs to be fumigated, reduce worker exposure to pesticides, increase the effectiveness of pest management, lower the overall cost of pest management, and increase the competitiveness of the United States in the international grain marketing system.

The effectiveness of pheromone traps to monitor insects is reduced in dusty environments. The addition of a cover to the trap will allow it to be used in milling and processing operations where dust has previously prevented accurate monitoring of insect levels.

STRATEGY 1.1.3: Measurement of product quality and marketability: Improve quality, uniformity, value, and marketability of commodities and other agricultural products.

PERFORMANCE GOAL 1.1.3.1: Demonstrate postharvest technologies that add value and improve quality.

Indicators:

During FY 1999, ARS will

in collaboration with National Cattlemen's Beef Association (NCBA) and the hide industry, conduct pilot tests to demonstrate the most cost effective method(s) to control or minimize hide damage, and develop recommendations for implementing the controls throughout the hide industry.

ACCOMPLISHMENTS: ARS was invited to an NCBA meeting to evaluate the status of rapid carcass dehairing to reduce bacterial contamination of the meat during hide removal. The main impediment to implementation of the procedure is handling the process chemicals without an expensive waste treatment system. Under a current CRADA with a commercial meat packer ARS has developed a potential solution on a pilot plant scale that will address this problem and still maintain the quality of the hide.

IMPACT/OUTCOME: The pilot plant process which is currently being incorporated into the construction design of a new beef packing plant should be on line within 12 to 14 months. Once demonstrated commercially, it is expected that the process will be adopted throughout the industry. Elimination of bacteria from the hide within minutes of slaughter will result in overall improvement in quality of domestic hides.

work with FSIS to expand the fiber database to include food products, such as microwavable meals.

ACCOMPLISHMENTS: Studies have begun, in cooperation with the FSIS, to examine the sampling techniques required for NIR and Raman analysis of dietary fiber in food products such as microwavable meals.

IMPACT/OUTCOME: The development of a successful spectroscopic method to analyze dietary fiber in fresh, homogenized, microwavable meals would decrease the time required for analysis of dietary fiber by the FSIS and food industry laboratories from five days to approximately thirty minutes.

in collaboration with the University of Georgia and Clemson University, apply enzymatic retting technology to flax straw from seed production and further develop tests of flax fiber properties for various industry segments, e.g., textiles, composites, and nonwovens.

ACCOMPLISHMENTS: Nine 25-lb. samples of flax straw were enzymatically retted and the properties determined after commercial processing. The enzyme formulations produced light colored fibers with acceptable strength and fineness, with some variations between samples. ARS scientists teamed with industry and university colleagues to establish a Flax Products subcommittee of the American Society for Testing and Materials. The subcommittee identified five important properties for which standards need to be developed for grading flax fiber.

IMPACT/OUTCOME: Since fiber flax is not produced in the U.S., the rapidly increasing demand is met by imports. Establishing a flax fiber industry in the U.S. requires a capability to process the fiber efficiently and effectively. The chief obstacles are an inability to ret (separate the fiber from the other stem tissues) cleanly and consistently, and a lack of grading standards so that buyers will know the properties of their purchases. ARS has led in developing reproducible procedures for retting fiber flax using enzymes, thus overcoming one of the major barriers. It is now expanding efforts to establish reliable grading procedures.

ACCOMPLISHMENTS: Researchers developed a laboratory procedure to more efficiently ret flax. Results provided the basis for testing blended yarns of cotton with flax fibers which have different properties.

IMPACT/OUTCOME: The accomplishments strengthen the basis for developing an industry in the U.S. to provide flax fiber for textile, composite, and paper/pulp applications. The development of fiber flax in Northern States offers an additional cash crop for rotation with traditional crops as well as providing a value-added product from seed flax straw, a byproduct of the linseed oil industry. In the Southern States, flax grown as a winter crop could provide economic benefits by double cropping with summer crops.

make the Stored Grain Advisor (SGA) software available free-of-charge on the worldwide web through the Grain Marketing and Production Research Center (GMPRC) home page.

ACCOMPLISHMENTS: Over 450 copies of SGA have been downloaded since it became available on the GMPRC web site.

IMPACT/OUTCOME: The SGA has been used as a key educational tool for producers and elevator operators throughout Oklahoma, Texas, Idaho, Montana, Nebraska, and South Dakota. It is currently being used by over 1,000 farmers and grain elevator managers in the U.S.; Oklahoma State University has used SGA to train over 1,500 grain elevator managers, and Montana State University has used SGA to train over 500. Because SGA recommends the use of nonchemical methods such as aeration to manage grain insects, elevator managers trained with SGA tend to rely less on chemical insecticides. This should result in lower insecticide residues in U.S. wheat and wheat products, and less worker exposure to insecticides.

cooperate with industry in the development of insect-monitoring strategies (including the types and locations of traps, etc.) leading to the development of a new insect trap that could be placed under grocery counters out of sight of customers. Insect trap catch data from representative grocery stores, food processing plants, etc., will be evaluated using spatial analysis software. Results will pinpoint sources of insect contamination, and lead to decreased pesticide use and improved control of insect pests.

ACCOMPLISHMENTS: A pheromone baited trap was developed that can be used under grocery store shelves to monitor insect activity.

IMPACT/OUTCOME: The development and commercialization of pheromone baited traps will increase their use in retail outlets and provide data that can be analyzed by spatial analysis software to produce

contour maps that will provide information to identify and locate infestations in packaged food products. Pinpointing infestations will reduce or eliminate pesticide use.

develop, assemble, and prepare to evaluate the energy performance of an experimental closed loop heat pump grain dryer in cooperation with a CRADA partner and the Department of Energy. Preliminary results show that water can be removed from wet grain at approximately one-fifth the cost of using conventional high temperature dryers.

ACCOMPLISHMENTS: The heat pump grain dryer system was developed in cooperation with a CRADA partner and the Department of Energy and evaluated for energy performance when drying shelled corn and milo. Energy input was less than the projected theoretical efficiency as a result of the low air-air exchanger component efficiency, but the performance was significantly better than any previously known heat pump dryer.

IMPACT/OUTCOME: The new heat pump grain dryer has the potential to reduce the total input operating energy requirements for drying grain and other commodities by more than 60 percent, although fixed equipment and management costs are projected to increase. Process model analysis showed that water could be removed from wet grain using this system at approximately one-fifth the energy cost of conventional high temperature dryers.

develop a relational database that can be used by customers to select wheat performance characteristics that are important for end-use quality. Quality analysis data from thousands of samples of different wheat varieties analyzed from the past 8 crop years have been placed into the database, which is now available on the Internet. This information can be used to determine which varieties have specific quality traits needed for each product manufactured.

ACCOMPLISHMENTS: ARS scientists developed a simple, user friendly relational database system which summarizes and interprets end use quality data.

IMPACT/OUTCOME: This database will allow breeders to more rapidly and accurately assess the quality potential of experimental breeding lines and ultimately facilitate the increased utilization of U.S. wheat flour for new and unique commercial products. The immediate and direct impact on the wheat industry will be to remove undesirable lines from early generation tests more rapidly, thereby decreasing the time for development of new varieties.

develop a differential scanning calorimetry (DSC) method to measure freezable water in frozen bread dough and monitor the biochemical changes that occur due to pooling of the water during prolonged storage.

ACCOMPLISHMENTS: The DSC method was developed by ARS scientists.

IMPACT/OUTCOME: Prolonged frozen storage and freeze thaw cycling were found to detrimentally affect gluten strength of the dough and quality of the baked bread.

PERFORMANCE GOAL 1.1.3.2: Provide knowledge and technology to expand and improve the grading systems for agricultural commodities and products.

Indicators:

During FY 1999, ARS will

release technology for calibrating High Volume Instrumentation (HVI) strength measurements of cotton fiber which is expected to be adopted worldwide as the official calibration procedure. This will ensure that

cottons are all subjected to the same standards worldwide, to enable cotton growers who produce a superior high quality product to receive compensation for it.

ACCOMPLISHMENTS: A calibration procedure has been implemented that requires only an update of the HVI (High Volume Instrumentation) system's software without mechanical modification. With cooperators in Germany, South Africa, and France, ARS has initiated efforts to expand the use of the new procedure globally.

IMPACT/OUTCOME: HVI measurements of fiber quality made it possible to automate cotton grading and eliminate the subjective aspects of grading by appearance and touch. New grading procedures have highlighted the quality and uniformity of U.S.-produced cottons and enabled American farmers to obtain a higher price, possibly as much as four cents per pound (\$20 per bale) on the world market. However, the system still is imperfect especially since there is no universal and absolute calibration standard against which all HVI systems can be compared. ARS' simple procedures for generating absolute calibration standards will allow such improvements to be put into place worldwide, thereby removing variation in quality determinations so that producers can expect to be paid a fair price for their product.

as part of an international trial, investigate the use of Artificial Neural Networks to measure protein in grain for regulatory purposes.

ACCOMPLISHMENTS: Sample sets from ARS/FGIS, the Canadian Grain Commission, Australia, and Europe were combined and a new network calculated. The results were better than any previous model.

IMPACT/OUTCOME: Protein content is a major criteria for setting prices in international trade of wheat and barley. A uniform method of analysis would level the field in worldwide trade of wheat and barley.

cooperate with Perten Instruments of North America to modify the Perten 4100 Single Kernel Characterization System by adding an NIR attachment. This instrument which will become commercially available can distinguish between red and white kernels of wheat with greater than 95 percent accuracy. This ability will become increasingly important as more commercial Hard White varieties of wheat are grown. The modified instrument will also detect the presence of internal insect infestation and bunted kernels, in addition to providing measurements of single kernel protein and moisture content.

ACCOMPLISHMENTS: A NIR spectrometer was added to the Perten Instruments 4100 Single Kernel Characterization System. This instrument is now commercially available and measures single wheat kernel attributes such as hardness, weight, diameter, moisture, protein, color class, presence of internal insects, and fungal damage. The Perten Instruments company and ARS have planned meetings with various grain industry segments to evaluate the economic impact of the SKCS 4100.

IMPACT/OUTCOME: This commercially available instrument will assist the grain industry in rapidly measuring grain attributes. The information will assist the industry in making informed decisions regarding segregation, preservation, quality maintenance, and price determination.

cooperate with the Grain Inspection, Packers and Stockyard Administration (GIPSA), in evaluating the field performance of 19 Perten 4100 instruments used in the official inspection system. This technology which was originally developed in ARS laboratories is being evaluated for its potential to become the standard method used to classify hard and soft wheats.

ACCOMPLISHMENTS: A method was developed to segregate hard red wheat by quality at the first buying point. Pilot milling and baking tests on quality segregated wheat were completed. The results validated the quality binning objectives.

IMPACT/OUTCOME: Publication and extensions of the results will translate to improved flour mill and baking performances and increased market value and potential demand for U.S. wheat.

in cooperation with GIPSA, continue the development of an objective method for odor analysis and develop a grain inspector aid (the "sniffer") to reduce exposure to particulates and dust during odor analysis. Six commercial prototypes were built and given to GIPSA for evaluation.

ACCOMPLISHMENTS: ARS scientists developed a list of 38 compounds associated with off odors in grains. Fabricated, assembled, evaluated, and delivered six commercial prototypes of the "sniffer" to GIPSA for field evaluations.

IMPACT/OUTCOME: The goal of this project was to reduce inspector exposure to particulates, dust, and toxins during odor analysis. Two "electronic nose" instrument companies have used information from this project to aid in development and testing of instruments that might eventually be used routinely by grain inspectors.

in cooperation with GIPSA, continue the development of the odor sample set and the evaluation of chemical odors. Two commercially available instruments for fragrance analysis were evaluated for their abilities to differentiate grain odors.

ACCOMPLISHMENTS: Researchers confirmed most of the compound odor associations previously identified and discovered some new ones. Two commercially available instruments for fragrance analysis were evaluated for their abilities to differentiate grain odors.

IMPACT/OUTCOME: The goal of this project was to reduce inspector exposure to particulates, dust, and toxins during odor analysis. Data could be used to set up an objective reference method for odor determinations at the GIPSA/FGIS Technical Center in Kansas City, Missouri.

PERFORMANCE GOAL 1.1.3.3: Demonstrate methods to measure the critical processing and end-use properties of agricultural commodities important to the agricultural marketing system including the processing industry.

Indicators:

During FY 1999, ARS will

determine optimal conditions for successful use of hydrodynamic pressure technology on meat products to enhance quality and safety, and further evaluate the technology's food safety benefits for meat.

ACCOMPLISHMENTS: Hydrodynamic pressure technology generated improvements in tenderness of freeze dried rehydrated reheated beef slices similar to companion steaks cooked from the fresh state, and improved chewability of meat sticks. Researchers also demonstrated a significant reduction of normal microorganisms in fresh and temperature abused meats using hydrodynamic pressure technology.

IMPACT/OUTCOME: Hydrodynamic pressure technology has demonstrated potential to improve acceptability of fresh and dehydrated meats by tenderizing the meat, while also reducing spoilage organisms and pathogens.

continue to collaborate with other rice producing countries to establish objective standards for rice quality.

ACCOMPLISHMENTS: A database is being compiled to include all cultivars in commercial use and the milling/drying regimes. New samples are being added which fill gaps in the starch (amylose/amylopectin) and protein content. To date, some 200 samples with laboratory and spectral data have been collected.

IMPACT/OUTCOME: When the database is sufficiently complete a model will be developed, in collaboration with Japanese and Australian scientists, that can be used for establishing the quality of rice in international trade.

develop quality performance standards for pork and poultry trimmings produced from Advanced Meat Recovery Systems (AMRS) and processing into comminuted livestock and poultry products, in cooperation with the National Meat Association and the American Meat Institute Foundation.

ACCOMPLISHMENTS: A performance standard was developed for soft bone constituents in AMRS trimmed beef based on the comparison of iron in hand trimmed beef compared to AMRS beef. A tolerance was developed and incorporated into the standard to account for analytical and process variability. In addition, a near infrared transmission spectroscopy method for prediction of soft bone constituents was developed. The results were transferred to the meat industry through the National Meat Association and the American Meat Foundation to FSIS.

IMPACT/OUTCOME: The establishment of a performance standard and a tolerance for soft bone constituents addresses consumer concerns about high levels of soft bone and hard bone constituents (i.e., bone marrow and calcium) in recovered meat to permit use of Advanced Meat Recovery Systems.

develop a combined analytical technique using capillary electrophoresis and liquid chromatography to separate the proteins found in wheat, rice, and sorghum. The protein patterns from wheat can be used to identify specific varieties. This technology is used by wheat breeders and commercial seed companies to verify varietal identification in their breeding programs. Specific information on the relative content of specific proteins can be highly correlated with end- use performance.

ACCOMPLISHMENTS: Researchers developed a method that allows rapid (20 minutes) and objective characterization of sorghum and maize proteins. A method was also developed that can be used to identify varieties of wheat, rice, oats, barley, sorghum, or maize in three minutes or less by fingerprinting or characterizing prolamin protein patterns.

IMPACT/OUTCOME: The protein (prolamin or glutelin) patterns from cereals (wheat, oats, rice, barley, maize, or sorghum) can be used to identify specific cultivars. This technology is used by wheat breeders and commercial seed companies to verify the genetic lines in their breeding programs. Specific information on the relative content of specific proteins can be highly correlated with end use performance. Barley cultivars with specific malting properties can be readily identified.

cooperate with GIPSA to develop a new lipid or fat extraction method for cereal grains and oilseeds, demonstrating that super critical fluid extractions of sunflowers and soybeans provide the same lipid results as normal solvent extractions in one-twentieth the time for approximately one-tenth the cost, and without the use of large quantities of flammable or toxic solvents. ARS is participating in evaluation experiments coordinated through the American Oil Chemists Society.

ACCOMPLISHMENTS: ARS scientists continued the development of methodology for extraction of lipids using super critical fluids. Researchers developed a method for the extraction of total nonstarch lipids from wheat and expanded the use of the technique to the extraction of lipids from all cereal grains including rice, oats, barley, millet, corn, rye, and sorghum. They developed the methodology for lipid extraction that will be collaboratively studied by members of AOAC International, the American Oil Chemists Society, the American Association of Cereal Chemists, and the International Cereal Chemists.

IMPACT/OUTCOME: The research provides a more safe, fast, environmentally friendly, and economical method for determining the lipid content in cereals. This information is vital in determining the involvement of lipids in end use functions and may also have important dietary and health implications.

STRATEGY 1.1.4: International technology interchange: Develop a strategy for selective international research interchange to supplement ARS technology developments and strengthen competitiveness of U.S. agriculture.

PERFORMANCE GOAL 1.1.4.1: Strategic alliances formed with specific foreign institutions, leading to the joint development of germplasm and value-added technologies mutually protected through intellectual property agreements.

Indicators:

During FY 1999, ARS will enhance its portfolio of foreign research partnerships consistent with the ARS mission and overall national programs. Tangible results will be documented through a series of co-publications and, where possible, co-patents.

ACCOMPLISHMENTS: ARS Collaboration with Former Soviet Union (F.S.U.): U.S. Government policy is to prevent the proliferation of weapons of mass destruction such as biological warfare. Part of the strategy involves U.S./F.S.U. participation in joint research toward peaceful and economically attractive applications of research work.

Under a Department of State-funded program, ARS teams have visited Russia twice to identify candidate F.S.U. scientists and project areas for potential partnerships. Visitors from Russia, Kazakhstan, and Uzbekistan have visited various ARS facilities and met with ARS scientists. Initial discussions have taken place, project ideas for collaboration have been generated, and several projects are in the stages of being funded. Dr. Floyd Horn, ARS Administrator, visited several institutes in Russia. He took a portfolio of research ideas generated by ARS scientists and a CD ROM computer program which accesses the ARS National Agricultural Library electronic catalog. He distributed these items as appropriate during his visit.

IMPACT/OUTCOME: All projects that are selected for collaboration are enhancements to the ARS national research program agenda. ARS scientists who have already collaboratively written a proposal with their F.S.U. partner estimated potential savings or enhancements to their program of from \$1 to \$3 million.

ACCOMPLISHMENTS: The Office of International Research Programs (OIRP) contacted Kazakhstan scientists and officials engaged in international affairs at the Kazakhstan Ministry of Science. OIRP wrote a proposal to the Department of Energy Initiative for Proliferation Prevention (also a State Department-funded program) on developing a bioprocess for a novel therapeutic product important for preventing food contamination, while bringing the Oak Ridge National Laboratory (ORNL) into the ensemble as a partner. The first thrust of a joint project involving ARS, ORNL and Kazakhstan has been funded.

IMPACT/OUTCOME: The initial results have attracted U.S. industrial interest.

ACCOMPLISHMENTS: ARS Collaboration with South Africa: In support of the Agriculture and Science and Technology working groups under the Gore-Mbeki Binational Commission, ARS established partnerships with the South African Government, the research institutes, and the university system.

With USAID and ARS contributing resources, OIRP has set up a collaboration with the University of Cape Town on Computer Aided Molecular Design, a basic research program with implications for development of valuable biomaterials from agriculture.

IMPACT/OUTCOME: This has led to co-publication of research.

ACCOMPLISHMENTS: Work on biological control of diamondback moth is important for both U.S. and South African agriculture.

IMPACT/OUTCOME: ARS-OIRP links with Fort Hare and Rhodes Universities have led to results useful for the diamondback moth project at the ARS European Biological Control laboratory.

ACCOMPLISHMENTS: ARS is working with Colorado State University to coordinate a graduate education and research fellowship program for promising early career South African scientists. These scientists, from formerly politically disadvantaged populations, are involved in agricultural research in areas most required by the South African Government.

IMPACT/OUTCOME: These interns will return to South Africa with scientific expertise in required fields. Strong scientific liaisons built with ARS and university scientists should last long after the actual fellowship has been completed.

ACCOMPLISHMENTS: Collaboration with the Agricultural Research Council (ARC) in Elsenburg, South Africa. Two projects provide technology transfer to small-scale farmers in rural areas. Establishment of a guayule crop (a latex based nonallergenic crop capable of growth in semi-arid areas) enable farmers to use land not suitable for other crops. The second project is the enhancement of South Africa's floriculture industry by establishing cultivation units of indigenous floriculture crops in the rural areas. A bi-product of this project is to curtail harvesting these flowers from the natural veld which is losing its ability to maintain the volumes of flowers needed by these farmers.

IMPACT/OUTCOME: The outcome is to expand and supplement rural income by transferring cultivation technologies to small scale farmers in rural areas. Guayule: Farm areas have been identified and farmers have agreed to help with the initial trials. Floriculture: Five farm areas (plantations) were established, technology transfer was provided, and the success of these trials can be seen in the plans for expansion of the plantations. Both of these projects are income generating.

ACCOMPLISHMENTS: Collaboration with ARS Animal Nutrition and Animal Products Institute in Irene, South Africa. This project, working with small-scale goat farmers in rural areas, has been extremely successful. The projects include alternative uses of goat hides, more nutritious feed for goats, and alternative uses of goat products.

IMPACT/OUTCOME: A new trade has been started using goat hides. Tanners keep a large number of artisans (approximately one to two hundred) engaged in producing products made of goat hides for commercial marketing. A commercial marketing center has been established in the Western part of South Africa to display and sell these products. Research is being conducted to offer alternative, nutritious goat food using excess fruits and vegetables. This enables the farmers to feed the goats nutritious food resulting in healthier goats providing better products to the farmer.

ACCOMPLISHMENTS: U.S./European Union (E.U.) New Transatlantic Agenda: As part of the New Transatlantic Agenda for Scientific Cooperation established by the U.S. Government and the government of the European Union, a U.S./E.U. Science and Technology Agreement has been negotiated. OIRP played a significant part in the negotiations and in the subsequent Joint Consultative Group activities. Food Safety has been chosen as an area of mutual research interest for the two sides. OIRP has co-chaired with an E.U. counterpart, the Food Safety Working Group sessions at the New Vistas Conference for Transatlantic Cooperation in Science, held in Stuttgart, Germany.

IMPACT/OUTCOME: A number of joint activities of potential benefit to both the U.S. and the E.U. have been established.

ACCOMPLISHMENTS: Collaboration with The Netherlands and Greece: There is considerable incentive to seek alternative sources of natural rubber. OIRP has set up agreements for ARS to work jointly with research institutions in The Netherlands and in Greece on natural isoprenoids.

IMPACT/OUTCOME: This has led to co-publication of research and to plans for further collaboration on plant and microbial terpenes.

ACCOMPLISHMENTS: Joint Work on Invertebrate Transgenesis: OIRP has set up a Franco-American collaboration on the interchange of technologies concerning molecular biological research on insects, shrimp, molluscs and other organisms. As a result of its success, the workshop has grown beyond the Franco-U.S. context and has extended its international reach. Three workshops have been organized, the most recent being in Crete, with support by the Molecular Biology Institute in Heraklion

IMPACT/OUTCOME: The collaborative network has become a fully fledged forum with active exchange of materials and methodologies, with benefits to ARS and other U.S. institutions. The attendees voted to continue this networking in the form of a periodic workshop because of the uniqueness and utility of this international workshop.

ACCOMPLISHMENTS: Food Safety Work with France: Under the recently formed agency for food safety (AFSSA), France has a network of laboratories dealing with food safety, veterinary drugs, animal health and animal food product quality. OIRP has introduced ARS scientists to the Veterinary Drugs Laboratory in Fougères.

IMPACT/OUTCOME: Interest has developed between ARS and Fougères to work together on diagnostic techniques for chemical residues in foodstuffs, the identification of intestinal flora and on probiotics.

OBJECTIVE 1.2: Develop new uses and products: "Develop new uses and new products for agricultural commodities, such as alternative fuels, and develop new crops."

STRATEGY 1.2.1: New and alternative crops: Develop new and alternative crops with economic and social value.

PERFORMANCE GOAL 1.2.1.1: Experimentally demonstrate the production of new, improved, and alternative crops and horticultural products with potential for successful introduction, and demonstrate the successful operation of aquaculture systems.

Indicators:

During FY 1999, ARS will

introduce new varieties of fruits and vegetables which will directly benefit consumers.

ACCOMPLISHMENTS: ARS scientists released a new citrus rootstock, "US-852," to fruit growers and nurserymen. This rootstock promises to be very popular due to its tolerance to phytophthora root rot, citrus blight, and cold temperatures. Higher yields were exhibited by grafted scion stocks.

The new potato varieties "Amy," "Bannock Russet," and "IdaRose," were released. "Amy" is a yellow-fleshed variety. "Bannock Russet" produces tubers with high internal quality. "IdaRose" is red skinned with excellent tuber quality and improved disease resistance.

Researchers released to breeders and producers ten multiple disease resistant pea breeding lines which combine resistance to root rot, powdery mildew, fusarium wilt, and/or pea seedborne mosaic virus.

A new red raspberry called "Coho" was released, which provides fresh market producers with an even later, high quality fresh cultivar than the current standard "Tulameen."

IMPACT/OUTCOME: This new disease resistant and cold tolerant citrus rootstock promises to replace existing rootstock material which growers are currently dependent upon. It will reduce crop losses and contribute to improved sustainability.

This potato germplasm provides growers with new high quality, disease-resistant varieties which will improve marketable yields and fill grower and distributor niche market needs.

The germplasm will enable commercial and public pea breeders to develop superior disease-resistant varieties.

The fruit of "Coho" mature later than the current standard fresh raspberry cultivar. The availability of "Coho" will extend the production season for red raspberry producers.

develop a cream-type southern pea cultivar with a green cotyledon phenotype which has some unique seed characteristics. An advanced breeding line is now in the second year of replicated trials. A large scale seed increase is underway in Georgia. ARS anticipates being able to request approval for release early in FY 1999.

ACCOMPLISHMENTS: ARS scientists released "Green Pixie," a small seeded, green cotyledon, cream type southern pea. Green cotyledon southern peas exhibit greater consumer appeal due to their green pigmentation

IMPACT/OUTCOME: Development of a southern pea cultivar with a persistent green seed color has been the subject of much interest among food processors because the peas produced by such a cultivar can be harvested at the dry stage of maturity without loss of their fresh green color. Green Pixie is expected to replace the popular cultivar, White Acre.

release a Downy Mildew resistant variety of broccoli developed in the doubled haploid breeding program. Resistance to this disease will have high value to U.S. seed companies actively involved in broccoli improvement. Downy Mildew is among the most destructive diseases of broccoli.

ACCOMPLISHMENTS: Two Downy Mildew resistant broccoli lines were developed, that are in the final stages of testing for release in FY 2000. This resistant germplasm will be valued by seedsmen for producing resistant hybrids for production worldwide.

Scientists developed double haploid broccoli breeding lines with high quality horticultural traits and resistance to Downy Mildew. They identified a genetic marker for mildew resistance.

IMPACT/OUTCOME: These findings will permit more rapid incorporation of resistance into broccoli germplasm for commercial breeding and development of new varieties.

PERFORMANCE GOAL 1.2.1.2: Experimentally demonstrate new and improved production, harvest, and postharvest handling procedures of these crops.

Indicators:

During FY 1999, ARS will

introduce improved postharvest handling procedures to extend the shelf life of fruits and vegetables which will directly benefit consumers.

ACCOMPLISHMENTS: ARS scientists have identified beneficial bacteria, heat treatments, calcium infiltration regimes, and bioactive coatings which, alone or in combination, successfully control blue mold decay of apple and other decay pathogens and prevent growth of the food borne pathogen E. coli 0157:H7.

IMPACT/OUTCOME: Postharvest losses due to decay of fruits during storage, shipping, marketing and home consumption are significant and represent a financial burden to both growers and consumers. These new methods to control postharvest disease provide safer control alternatives and address public concern over safety, environmental concerns, and pathogen populations that are resistant to chemical fungicides.

introduce three particle films that repel insects which represents a major advance in pest control. In this technology, inert particles are applied to plant surfaces which alter the tactile environment of the plant and change the behavior of insect pests by inhibiting feeding and/or oviposition. A wide range of insect pests have been controlled by this technology which was developed under a CRADA with Engelhard Corporation of Iselin, New Jersey. EPA registration for the three films has been granted.

ACCOMPLISHMENTS: In 1999 over 600,000 lbs. of the new particle film insect repellent were sold by the Engelhard Corporation. The product is formulated as a wettable powder and can be mixed directly with water.

IMPACT/OUTCOME: Excellent control of pear psylla in apple orchards in Washington State was obtained in the 1999 field season. Good repellency was also obtained with codling moth. The product will probably be used in combination with pheromone disruption for control of this insect. Particle film also gave good control of plum carculio on the East Coast. An added benefit of the particle film is the reduction in sunburn damage to apple foliage with a resulting increase in tree growth and fruit size.

introduce the use of sugar-ester compounds as a novel approach for insect control. Sugar-ester compounds which have been synthesized are highly effective in controlling a wide range of soft bodied insect pests. These materials applied using standard spray technology are very low in toxicity and have a very short residual activity. This technology was developed under a CRADA; registration is expected in October 1999.

ACCOMPLISHMENTS: In cooperation with AVA Chemical Ventures, a highly effective formulation of sugar-ester compounds has been developed as a contact insecticide.

IMPACT/OUTCOME: Insects controlled with this material include thrips, whiteflies, aphids, scales, psylla and mites. The sugar-ester compounds have been formulated as a water soluble mixture for direct spray application. Applications may also be made using a fogging apparatus for greenhouse use. Registration of this new product is expected by mid- to late 2000.

STRATEGY 1.2.2: New uses and products: Develop new food and nonfood uses and products from plants and animals, and new processes and other technologies that add value.

PERFORMANCE GOAL 1.2.2.1: Experimentally demonstrate improvements in processing technologies and develop new bioproducts and uses that have potential to increase demand for agricultural commodities.

Indicators:

During FY 1999, ARS will

further cooperate with industrial partners to utilize Fantesk technology. Additional CRADAs will be sought for application of Fantesk to drug delivery systems and cosmetics.

ACCOMPLISHMENTS: In cooperation with CRADA partner, Shrieve Chemical, lubricity tests of Fantesk formulations in oil well drilling muds carried out by an independent testing laboratory were successful. Research in cooperation with another CRADA partner, Hy-Gene, has shown that Fantesk formulations function as moisturizing lotions and barrier creams. ARS is working with a third CRADA partner, Union Camp Corporation, to develop new water-based lubricant systems for industrial applications. ARS is also working under confidentiality agreements to develop Fantesk products as agents for drug delivery and for use in low fat foods.

IMPACT/OUTCOME: Seedbiotics, a Fantesk licensee, is currently marketing a Fantesk containing seed coating formulation to inhibit water penetration of the seed surface during cold weather planting. Further adoption of Fantesk technologies will create new markets for biobased starches and oils.

provide stakeholders with information pertaining to new enzyme technology for the hydrolysis of biomass, particularly corn fiber. Enzyme technology is environmentally friendly and has the potential for converting biomass to ethanol (or a variety of valuable coproducts) that is economically feasible.

ACCOMPLISHMENTS: Research findings concerning a novel enzymatic process for the conversion of corn fiber to fermentable sugars were provided to stakeholders in the form of publications, formal and informal meetings, presentations and consultations. Findings were presented at such scientific meetings as the Distillers Grains Technology Council's Symposium, and in meetings with representatives of a major corn processing company and an economic development group.

IMPACT/OUTCOME: An enzymatic process is an attractive alternative to chemical hydrolysis of biomass, since even mild acid hydrolysis generates fermentation inhibitors. Research has provided a scientific basis for continuing studies to develop economical processes for the production of valuable coproducts from biomass. Two formal agreements exist with industrial partners for commercial evaluation of coproduct technologies, and a CRADA is pending with a third partner.

work with the Biotechnology Research and Development Corporation (BRDC) to transfer starch-based plastic technology to the private sector and ultimately to American consumers.

ACCOMPLISHMENTS: BRDC has exclusively licensed the Dow Chemical Company for the right to make loose fill packaging materials and granted it an option to license the technology for all other uses.

IMPACT/OUTCOME: New markets for cereal and legume starches and flours will be created. These starch-based plastics will biodegrade in the environment.

complete most of the technology transfer efforts pertaining to Z-trim, and, if necessary, work closely with industry to further utilize the invention. Z-trim human nutrition studies will be continued.

ACCOMPLISHMENTS: Licensing arrangements are in various stages of negotiation for Z-trim and other Trim technologies. Much information will be disseminated during the next three years.

IMPACT/OUTCOME: Z-trim and related Trim technologies could have a significant impact on preventing heart disease by providing Americans with low fat food alternatives. New markets for grain, as well as American agribusiness jobs should continue to grow as Z-trim and other Trim technologies are commercialized.

continue technology transfer efforts pertaining to Amaizing Oil. Because of its health benefits and the fact that its source is a very abundant material, Amaizing Oil is a good candidate for export. The competitiveness of Amaizing Oil on the world market will be evaluated.

ACCOMPLISHMENTS: A patent for Amaizing Oil (corn fiber oil), US 5,843,499) was issued on December 1, 1998. Although one company licensed the patent for two years, it is now available for licensing. Currently, several major companies are competing for this license. Our patent application for Corn Fiber Gum is co-owned by our CRADA partner (the CRADA began in June 1997 and will continue through May 2000), and the scale-up and cost analysis for corn fiber gum is being completed at the company.

IMPACT/OUTCOME: If functionality testing and cost analyses are successful and internal approvals are obtained within the partner company, production of Zeagen could begin in 2000.

develop cost-effective methods for extracting Amaizing Oil from corn milling byproducts such as corn fiber (from either wet milling or modified dry grind ethanol processes).

ACCOMPLISHMENTS: ARS researchers developed a process (and applied for a patent) to obtain "quick fiber oil" and optimized process parameters to produce this cholesterol-lowering oil that contains high levels of phytosterols.

IMPACT/OUTCOME: This healthy high-value product could increase demand and value of corn and corn byproducts, especially corn fiber, a low value byproduct of fuel ethanol production.

improve the already commercialized Lambent hydraulic fluid made from vegetable oils to meet the "Blue Angel" environmental and performance standard by improving process catalysts.

ACCOMPLISHMENTS: An alternative catalyst used at very low levels was developed that brought the final product up to industrial standards. In addition, the improved product is very similar in color to off the shelf high quality motor oils.

IMPACT/OUTCOME: The properties and price of this new base oil/hydraulic fluid will open huge new markets for high content oleic crops. Replacement of petroleum-based lubricant products with biodegradable alternatives will be possible in large part due to this new high performance product.

develop a cooperative five-year plan with growers, processors, and end-users for the commercialization of lesquerella as an alternative crop for Arizona, Texas, and New Mexico.

ACCOMPLISHMENTS: Lesquerella grown in Arizona, New Mexico, and Texas in 1999 will increase in acreage over the next five years but at a slower pace than originally planned. Approximately 4,000 pounds of seed was cleaned and the oil extracted for further experimentation and seed cleaning process development. Data from analyses were provided to assist in development of new lesquerella varieties.

IMPACT/OUTCOME: Markets for lesquerolic acid and other products will be developed so that lesquerella will ultimately become an alternative cash crop for farmers.

GOAL 2: To Ensure an Adequate Food Supply and Improved Detection, Surveillance, Prevention, and Educational Programs for the American Public's Health, Safety and Well-being.

Analysis of Results: This goal is the focus of much of ARS' research related to food safety and the security of the US agricultural production system. Under Goal II, 52 Indicators are aligned under 9 Performance Goals. Because of the unique and dynamic nature of research, several Indicators were added to the Report that did not first appear in the Annual Performance Plan for FY 1999. This was done

to ensure that significant accomplishments that were not anticipated last year were reported. While it is not possible to report research accomplishments numerically, the progress projected in all 52 Indicators was completed or substantially completed during FY 1999.

OBJECTIVE 2.1: Secure food and fiber system: Maintain a safe and secure food and fiber system that meets the Nation's needs now and in the future.

STRATEGY 2.1.1: Plant and animal production systems: Improve efficiency of agricultural production systems to ensure the security of the Nation's food, fiber, and energy supply.

PERFORMANCE GOAL 2.1.1.1: Demonstrate increases in productivity above current levels using sustainable technologies.

Indicators:

During FY 1999, ARS will use genetic crosses to combine heat resistance traits in a single line of . Elite lines will be developed and tested, resulting in new high yield germplasm for incorporation into varietal breeding programs, and eventually in the production of new high yielding varieties for producers.

ACCOMPLISHMENTS: The okra leaf and nectariless traits were combined in heat resistant pima cotton germplasm and released to the public for use in breeding programs. Okra leaf has been demonstrated as a nonpreference trait for white flies (they will preferentially feed on other types of plants), while nectariless plants are somewhat resistant to the pink bollworm, a serious pest of cotton in the Southwestern U.S. This adds to the more than 230 germplasm releases from this research program over the years in support of the pima cotton industry.

IMPACT/OUTCOME: Pima cotton is a high value specialty cotton grown on about 200,000 acres from Texas to California. For 40 years, ARS cotton breeders produced pima cotton varieties that were grown on 100 percent of pima cotton acreage, which produced fiber that rivaled famed high quality Egyptian cottons. The industry became so successful that in the mid-1990s, private seed companies began to breed and sell pima cotton seeds. No longer needing to breed varieties, ARS now performs research in basic genetics, bringing in new genes for yield, quality, or pest and disease resistance, and releasing the germplasm lines to breeders for their use. This is still the only source of new genes for pima varieties and is the foundation of future progress for improving the crop and increasing its value.

PERFORMANCE GOAL 2.1.1.2: Demonstrate a more efficient and cost-effective use of resource inputs while increasing productivity above current levels.

Indicators:

During FY 1999, ARS will demonstrate additional technologies to increase productivity above current levels.

This indicator is so vague that ARS had decided to revise it in future Plans and will report accomplishments in FY 2001.

STRATEGY 2.1.2: Plant, animal, and ecosystems protection: Improve integrated management systems that contribute to the protection of plants, animals, and ecosystems against pests (insects, weeds, pathogens, etc.).

PERFORMANCE GOAL 2.1.2.1: Demonstrate new integrated technologies to protect plants, animals, and ecosystems.

Indicators:

During FY 1999, ARS will

continue to demonstrate, in cooperation with the Agricultural Experiment Stations in Iowa, Kansas, and Illinois, and corn growers in the Midwest, that an attracticide bait, when used on an areawide basis to control corn rootworm, will reduce corn rootworm soil insecticide use by more than 90 percent and total corn insecticide use by one-half. This areawide program is in support of USDA's goal of placing integrated pest management on 75 percent of the Nation's cropland by the year 2000. It is the first one to target corn pests. This program is a 5-year demonstration project that should lead to overall grower adoption in the year 2000.

ACCOMPLISHMENTS: The corn rootworm is the number one corn pest in the U.S. ARS scientists at the Insect Biocontrol and Insect Chemical Ecology Laboratories in Beltsville have discovered and isolated an insect feeding stimulant, cucurbitacin-E, from a bitter mutant of the Hawkesbury watermelon. Having developed an extraction method that produces high cucurbitacin yields, researchers mixed the chemical with D&C Red Dye #28, Sevin, Spinosid, or Admire, and found it to be as effective or better than the commercial bait (Slam) in reducing southern corn rootworm and striped cucumber beetles in Maryland, and western and northern corn rootworms in South Dakota.

IMPACT/OUTCOME: This technology promises to significantly reduce crop losses and control costs from the current estimate of \$1 billion per year. A patent has been granted for use of the bait with xanthene dyes, and amended to include use of the bait with other water soluble toxins. As a measure of industry interest, there are 11 confidentiality agreements and five material transfer agreements with companies. Several companies have expressed interest in licensing the patent technology.

ACCOMPLISHMENTS: ARS scientists at Brookings, South Dakota, have been leading a five year areawide pest management partnership program with emphasis on corn rootworm using an adult insect attracticide bait as the primary management tactic, as well as the integration of the biologically-based technology for other corn pests. Adaptation of western corn rootworm populations at the Illinois/Indiana site where the pest has changed its behavior by laying eggs in soybeans that are rotated with corn has been troublesome but will be addressed by possibly extending the program for an additional year and using improved attracticide formulations with longer residues.

IMPACT/OUTCOME: After three years of the corn rootworm areawide program, initially conducted at five primary sites in Illinois, Indiana, Iowa, Kansas, South Dakota, and Texas, reduction in root damage to corn has been greater than 90 percent, and soil insecticides decreased by 80 to 90 percent.

continue to demonstrate, in cooperation with the Agricultural Experiment Stations in Washington, Oregon, and California, and apple and pear growers in the Pacific Northwest, that mating disruption technology used on an areawide basis to control codling moth will decrease application of chemical insecticides by more than 80 percent for this serious pest. This areawide program is in support of USDA's goal of having integrated pest management on 75 percent of the Nation's cropland by the year 2000. The program is a five year demonstration project that should lead to overall grower adoption in the year 2000.

ACCOMPLISHMENTS: ARS scientists at Wapato, Washington, have led an areawide management partnership program since 1995 across Washington, Oregon, and California, using mating disruption, sanitation, natural enemies, and early season *Bacillus thuringiensis* (bt) sprays. Since the beginning of the program, organophosphate insecticide use has significantly declined. Some orchard growers have not

sprayed for codling moth or other orchard pests in two years; in other instances pesticide use has been reduced by more than 70 percent.

IMPACT/OUTCOME: Under the codling moth mating disruption areawide program, fruit damage has been reduced below the 0.1 percent threshold, and the cost of control has been less than in orchards where conventional pesticides have been used. In 1995, there were 68 growers and 3,109 acres (five sites) in the program; in 1994, more than 600 growers had entered 21,000 acres (22 sites) in the technology program.

ACCOMPLISHMENTS: Understanding the genetic basis of tolerance to bt toxin is a key part of slowing down the rate at which populations of cotton bollworm become resistant. Researchers at the Insect Biology and Management Systems Research Laboratory in Tifton, Georgia developed an improved bioassay to monitor and detect tolerance to the bt toxin and used the assay in conjunction with quantitative genetic analyses to examine the heritable nature of bt toxin tolerance. Significant heritable variation in the tolerance of wild populations of cotton bollworm was found to be caused by more than one gene, which shows that the genetic basis for resistance to bt toxin is present in wild cotton bollworm populations.

IMPACT/OUTCOME: A grower financed areawide management program using the bollworm virus has been proposed for the Mississippi Delta at an estimated cost of \$11.61 per cotton acre for a total of \$2,906,000. These studies with lower bollworm virus application rates have demonstrated that the cost of the grower financed program may be reduced to \$1,905,000, for a savings of more than \$1 million to the grower.

develop new and expanded approaches to weed management that will use all management tools available, including biological control, more competitive crops and forage grasses, and strategies to prevent occurrence and spread of herbicide-resistant weeds.

ACCOMPLISHMENTS: ARS is increasing research into biologically based weed management, which emphasizes biological control (use of live natural enemies to control weeds) and cultural control (use of competing plants, revegetation, cover crops, etc.). This research benefits production agriculture, natural areas, small farms and organic farming. For example, melaleuca is a major invasive weed that infests about 400,000 acres in the Florida everglades. In 1997 ARS released the melaleuca snout beetle (*Oxyops vitiosa*) from Australia, the home of melaleuca, which is already spreading. Saltcedar is an invasive exotic weed deliberately introduced from Eurasia that invades virtually all riparian corridors in the West. A multi-agency "Saltcedar Consortium" was developed and led by ARS to aid in program planning and implementation and for regulatory approval, and the first biological control agent, a *Diorhabda* leaf-feeding beetle, was released in 1999 into field cages at eight sites in six Western states. Plans are in place for revegetation, long-term evaluation and monitoring. A multi-State and multi-agency biologically based areawide weed management program for leafy spurge was initiated by ARS that is transferring biological, cultural control, chemical and mechanical control strategies to customers in the West. A detailed assessment of weed problems facing organic farming is being conducted in the Buckeystown, Maryland, area, with three key organic farmers, and a similar assessment is planned for Salinas, California. Biologically based integrated weed management options are being developed for many other weed species in several states.

IMPACT/OUTCOME: More herbicides are applied in the U.S. than any other pesticide group—some 6 million pounds (72% of all pesticides used) in 1997 (compared to 1.7 million pounds of insecticides, 0.17 million pounds of fungicides, and 0.4 million pounds of all other pesticides). Sustainable, low-cost, biologically based integrated management of major weeds will impact farmers and ranchers significantly by reducing the quantity of herbicides they apply. Restrictions on herbicide use in natural areas and around water point to the need for biologically based weed management in these areas. The organic farming industry rated weed management as their top priority. These investigations will help quantify the nature and distribution of weeds that impact crop, range and natural areas.

sustainable management strategies for controlling wetland and aquatic weeds.

ACCOMPLISHMENTS: Melaleuca currently infests about 400,000 acres of Florida's Everglades and invades bordering pasture lands. In October 1997, scientists at the Aquatic Weed Research Laboratory in Ft. Lauderdale, Florida, released 3,300 larvae of the melaleuca snout beetle (*Oxyops vitiosa*), the first biological control agent to be approved for release against this major landscape changing aquatic and wetlands weed.

IMPACT/OUTCOME: The released weevils increased explosively, so that by June 1999, there were an estimated 72,000 adults and 14,000 larvae at the release site; over 90 percent of the 49,000 melaleuca plants at the site had sustained weevil damage. This research shows that field nurseries can greatly increase the number of weevils available for distribution to other sites, and simultaneously reduce the labor necessary to produce them.

expand testing of an ecologically-based management strategy for saltcedar.

ACCOMPLISHMENTS: Saltcedar is an invasive exotic weed intentionally introduced from Eurasia for erosion control and as an ornamental plant which has escaped cultivation. It now invades virtually all riparian corridors in the West. A multiagency "Saltcedar Consortium" was developed and led by ARS to aid in program planning. The first biological control agent for saltcedar, a *Diorhabda* leaf feeding beetle, was released from field cages at eight sites in six Western States, and plans are in place for long-term evaluation and monitoring.

IMPACT/OUTCOME: After extended negotiations, approval for release of the leaf feeding beetle has been obtained from the Animal and Plant Health Inspection Service and the Fish and Wildlife Service. This is a breakthrough case involving approval for release of a biological control agent under both the National Environmental Policy Act and the Endangered Species Act. The Saltcedar Consortium is a model of how a team-based program can plan, implement and monitor a major weed management program.

development of integrated weed management strategies to improve grasslands.

ACCOMPLISHMENTS: In the Central Great Plains, more than 19 million acres of cropland are economically marginal and better suited to production of perennial grasses. Over 70 million acres of degraded rangeland in the Northern Great Plains need renovation and restoration. It was determined that the herbicide PLATEAU has the potential to revolutionize the technology of grassland renovation and restoration. A model was developed utilizing PLATEAU as the key component of integrated weed management strategies.

IMPACT/OUTCOME: The grassland improvement model describes the process of grassland deterioration and the importance of using multiple strategies to improve grassland productivity. It was shown that PLATEAU is the key component that can be used to establish native warm season grasses and legumes on marginal and highly erodible cropland and to reclaim leafy spurge infested grasslands.

develop new and expanded strategies to combat some of the most serious diseases that have only recently been found in the U.S., or which would pose serious threats should they occur. The initial diseases to be addressed include wheat scab, potato blight, gray leaf spot, and sorghum ergot.

ACCOMPLISHMENTS: Researchers isolated bacterial antagonists to the fungus causing wheat and barley scab. They identified new wheat and barley germplasm with resistance to scab, and potato germplasm resistant to late blight and golden nematode. Improved mathematical models were developed using environmental data to more accurately predict the threat of plant disease losses in wheat, potatoes, citrus and other crops.

IMPACT/OUTCOME: Emerging and reemerging diseases pose serious threats to crop production in the U.S. Some of the new methods being developed that do not depend on chemical pesticides will reduce losses due to these pathogens, while minimizing the risk of damage to the environment. Improved forecasting of disease potential will increase the effectiveness of fungicides and reduce the frequency of applications.

develop and implement new technologies for detection and identification of pathogens on germplasm being introduced into the U.S.

ACCOMPLISHMENTS: ARS researchers at Beltsville, Maryland, developed molecular diagnostic tests for eight different viroids that infest fruit trees, sugarcane, potatoes, and ornamentals. These tests are more accurate and more sensitive than conventional inoculation/observation tests used previously.

IMPACT/OUTCOME: These new detection methods are helping to protect U. S. agriculture from severe economic losses caused by these microbial diseases. They are also significantly reducing the time required to release healthy germplasm to importers, and will likely reduce the cost of maintaining healthy commercial plant material.

ACCOMPLISHMENTS: ARS scientists developed nucleic acid-based detection methods for six different viroids that cause diseases of clonally propagated crops routinely quarantined upon entry into the U.S. Similar assays were also developed for the citrus variegated chlorosis pathogen, ratoon stunting and leaf scald of sugarcane, peanut stripe virus, and various phytoplasma pathogens on several crops.

IMPACT/OUTCOME: The diagnostic tests may substantially streamline quarantine and disease free certification procedures, thus protecting U.S. crop production from economic loss while also facilitating rapid germplasm exchange and availability as breeding material for improvement of U.S. crops.

utilize infectious clones of citrus tristeza virus (CTV) to locate viral genes for replication, aphid transmission, disease development, and other properties (in collaboration with the University of Florida).

ACCOMPLISHMENTS: A full length infectious clone of the genome of CTV was produced and a procedure was developed to successfully infect both citrus protoplasts and citrus trees.

IMPACT/OUTCOME: The availability of the full length clone will allow researchers to modify the CTV genome at will and observe the effects of modifications at particular sites. By doing so, they will be able to identify specific viral genes and their functions, including those that lead to severe infections. This may, in turn, lead to novel methods for managing CTV in U.S. citrus production, a threat enhanced by the recent introduction of the CTV insect vector, the brown citrus aphid.

utilize plant transformation technology to enhance resistance to various plant pathogens.

ACCOMPLISHMENTS: Leaf rust resistance genes from wild relatives of wheat were tagged so that they may be followed in the development of new varieties of rust resistant germplasm. Flowering bulb crops (gladiolus and Easter lily) were transformed with viral genes and rendered resistant to the viruses. A rhododendron transformation system was developed that can be used to produce transgenic plants resistant to diseases and insects.

IMPACT/OUTCOME: Plant transformation with foreign genes has been shown to be effective for controlling diseases and pests. In some of these cases, especially those in which no sources of resistance are known that can be used in conventional breeding, genetic transformation may be the most effective means for protecting crops and maintaining yields and profitability.

develop, identify, and characterize biological agents useful for control of plant pathogenic fungal and bacterial diseases.

ACCOMPLISHMENTS: Antibiotics have been identified in soil bacteria that protect crops against plant pathogenic fungi. The genes involved in synthesis of such antibiotics have been isolated and introduced into other bacteria to give them improved overall control effectiveness.

IMPACT/OUTCOME: This work provides a better understanding of how biological control works and demonstrates how to make it more reliable and useful to growers. Eventually, bacteria associated with a particular crop could be modified to produce appropriate antibiotics to protect it from disease causing agents.

evaluate alternatives to soil fumigation with methyl bromide to control diseases, nematodes, and weeds in strawberries, tomatoes, peppers, grapes, and other annual and perennial crops (in cooperation with the University of Florida and University of California).

ACCOMPLISHMENTS: ARS scientists developed a system for applying alternative soil fumigants through drip irrigation systems for California strawberry production.

IMPACT/OUTCOME: This system has been shown to be about 90 percent as effective as fumigation with methyl bromide which is being phased out. The procedure can be incorporated into most current cropping systems and may be an economical alternative to methyl bromide.

ACCOMPLISHMENTS: Nonpathogenic variants of fusarium have been shown to protect plants from pathogenic forms of the fungus.

IMPACT/OUTCOME: Soilborne diseases such as fusarium now controlled by soil fumigation with methyl bromide are expected to pose serious problems for farmers after the methyl bromide phase out. Treatment of plants with the nonpathogenic variants may significantly reduce disease losses in some crops.

identify new sources of resistance to nematodes and diseases in cotton, wheat, soybeans, peanuts, and other crops.

ACCOMPLISHMENTS: A number of sources of resistance to diseases and nematodes in several crops were identified. They include: the soybean variety, "Fowler," which was released and has good resistance to the soybean cyst nematode; potato germplasm with resistance to late blight and the golden nematode; a corn inbred with resistance to the maize chlorotic dwarf virus; perennial soybean relatives with resistance to sclerotinia stem rot and sudden death syndrome; barley and wheat germplasm with resistance to scab; strawberry germplasm with resistance to bacterial diseases, angular leaf spot; Asian grape varieties showing resistance to Pierce's disease; and resistance to bean yellow mosaic virus in clover.

IMPACT/OUTCOME: Plant diseases cause at least \$8 billion in losses to U.S. agriculture each year. Planting resistant varieties is the most cost effective, environmentally sound method for reducing such losses. Because pathogens are continually evolving to overcome resistance of commercial varieties or become infective on new hosts, it is a constant challenge to maintain acceptable levels of genetic resistance in nearly all crops. Identification of new sources of resistance for introduction into crops and preserving their ability to resist pathogens is extremely important. The new sources of resistance will be used to improve U.S. crop varieties.

field test a combination of bacterial and fungal agents for the biocontrol of soilborne diseases of tomatoes, peppers, melons, corn, and other crops.

ACCOMPLISHMENTS: Combinations of a fungus (*Trichoderma virens*) and a bacterium (*Berkholderia cepacia*) were evaluated for the biological control of soilborne diseases of tomato, melon, peppers, and

other crops. The combination was found to be better than either agent alone for controlling many of the diseases.

IMPACT/OUTCOME: Biological control of plant diseases will become increasingly important for reducing the use of chemical pesticides and replacing them as they become unavailable because of loss of registration. The use of biological agents will enable growers to profitably produce crops despite disease pressures previously controlled through pesticides and fungicides.

identify factors affecting the spread of several emerging diseases with emphasis on wheat and barley scab, sorghum ergot, citrus canker, citrus tristeza virus, and potato late blight.

ACCOMPLISHMENTS: Environmental limits on the survival of potato late blight fungus spores were defined and used to improve a mathematical model for spread of the disease. Survival of infective structures in several other fungal diseases was measured as was the timing of the production of their structures. This was then related to disease spread. The timing of application of fungicide sprays was optimized for the control of diseases. For the first time, the spread of bacterial diseases of bean was shown to occur even in the absence of rain splashing. Investigation of the spread of the citrus canker disease in Florida demonstrated that the disease can spread faster and farther than previously thought.

IMPACT/OUTCOME: Improved knowledge of the spread of plant diseases is often crucial for their control. Growers need to know when conditions are conducive to spread so that they may limit losses by taking appropriate actions at the optimal times. Since mathematical models are improving as better data is accumulated, more and more growers are relying on them when making pesticide application decisions. Furthermore, knowledge of the way pathogens spread in nature often forms the basis for cultural modifications that reduce disease losses. The increased spread of citrus canker will likely impact the eradication and control efforts currently underway.

continue to develop and test naturally derived experimental materials that reduce populations of blue-green algae in catfish ponds without suppressing other types of algae or producing harmful side effects. Blue-green algae are responsible for considerable economic losses to catfish producers because of off flavors.

ACCOMPLISHMENTS: An invention disclosure has been filed describing the novel pesticidal activity of a natural product derivative that may yield promising results as a selective blue-green algaicide in the field.

IMPACT/OUTCOME: This development, if successful in field testing, will address a serious problem (off flavor) confronting producers of farm raised commercial fish.

*monitor the resistance of insect pest populations to transgenic plants that contain the toxin gene from *Bacillus thuringiensis* (bt). This activity is part of a long-term strategy to keep transgenic pest resistant crops effective, so they can be used in integrated pest management strategies to reduce chemical pesticide use.*

ACCOMPLISHMENTS: Since 1996, ARS scientists at Stoneville, Mississippi, have been monitoring field populations of tobacco budworm and cotton bollworm in the Eastern half of the U.S. cotton belt for tolerance to cotton plants containing the *Bacillus thuringiensis* (bt) insecticidal toxin gene. During this period, cotton bollworm from the Mississippi Delta has shown increased tolerances to the bt toxin. Areas producing the greatest increase in tolerance had a greater percentage of acreage planted in bt cotton. In general, tolerances of tobacco budworm did not change, with the single exception being the third generation of tobacco budworm collected from the Mississippi Delta. The small changes in tolerance, however, suggest that although insect populations may be more tolerant to the bt toxin, the tolerance does not seem to be at a level to cause control failures in the field so far.

IMPACT/OUTCOME: To delay or manage resistance of insects to transgenic *bt* plants, it is necessary to monitor insect pests of cotton for changes in their tolerances to the *bt* toxin. Quantifying the amount of heritable variation and tolerance in field insect populations will help determine the amount of refuges to be used in order to slow resistance development to the *bt* toxin contained in *bt* crops.

a new bioassay and model for personal protection from biting arthropods.

ACCOMPLISHMENTS: ARS scientists at Beltsville, Maryland, developed a new bioassay technology which is significantly more efficient than anything previously used in repellent research. ARS scientists at Gainesville, Florida, have discovered compounds from human skin that attract mosquitoes and other compounds that repel them. This knowledge is being used to develop attractant antagonist-based personal systems for human, and zooprophylaxis technology for livestock.

IMPACT/OUTCOME: This research will provide the Department of Defense with alternate repellents to Deet for protecting U.S. troops overseas from blood sucking and disease transmitting insects.

identify biological control strategies for the mosquito vector of dengue fever and yellow fever.

ACCOMPLISHMENTS: ARS scientists in Gainesville, Florida, found that the microsporidium *Edhazardia aedis* is an excellent candidate for the biological control of *Aedes aegypti*. New technology is needed because of mosquito resistance to insecticides, and to reduce human/animal/environmental exposure to pesticides. ARS scientists in Gainesville, Florida, are currently working with Brazilian scientists to begin field testing *Edhazardia aedis* for the biological control of *Aedes aegypti* in Brazil.

IMPACT/OUTCOME: Biological control provides a no risk and sustainable method for the control of *Aedes aegypti* and the several human and animal diseases this mosquito transmits.

develop new bait technologies that will allow early detection and control of the Formosan Subterranean Termite (FST).

ACCOMPLISHMENTS: ARS scientists in New Orleans, Louisiana, have developed a nutritionally-based termite bait matrix that termites consume more readily than other forms of cellulose, which makes it possible to more effectively monitor termite populations and improve termicide delivery to the colony.

IMPACT/OUTCOME: This tool will help pest control operators detect various levels of FST infestations and control them with minimum amounts of termiticides.

precision targeting of ticks on hosts.

ACCOMPLISHMENTS: ARS scientists at Kerrville, Texas, have developed and field tested a mechanical tick device that places a collar on deer as it comes to a feeder which rids it of its ticks. The device is made of a reflective material impregnated with tick killing pesticides and embedded microchips that can reveal the identity of the deer to a wildlife manager.

IMPACT/OUTCOME: This tool will help public health officials control ticks and tickborne disease by targeting the ticks infesting an animal's neck and head. It will help wildlife managers deal with the deer population more efficiently.

develop, identify and field test new biocontrol agents to control fire ant infestations.

ACCOMPLISHMENTS: ARS scientists in Gainesville, Florida, imported and released biocontrol agents in fire ant infested areas. Fire ant populations were reduced by as much as 61 percent in a field site where natural infections of the fire ant pathogen, *Thelohania solenopsae*, have been monitored for over two and one-half years. Infections of the fire ant pathogen were detected in six of 10 States where field

inoculations were made in 1998 to evaluate the efficacy of the pathogen under different geographic and climatic conditions. In addition, ARS scientists released the phorid fly at test sites in six Southern States where they have expanded to cover more than 120 acres at one site. Flies were permanently established at one site. Also, flies were seen attacking a fire ant colony almost three miles from the nearest known fire ant infested population. Scientists are using biocontrol agents as a component of IPM strategies to control fire ants.

IMPACT/OUTCOME: This technology, when integrated with baits, will significantly reduce the use of pesticides for control of fire ants in urban, suburban, and agricultural environments.

identify DNA probes for the surveillance of pesticide resistance in cattle fever ticks.

ACCOMPLISHMENTS: Cattle fever ticks, *Boophilus microplus* and *B. Annulatus*, were eradicated from the Southern U.S., but efforts to keep them and the diseases they transmit to cattle from spreading back into the U.S. from Mexico are complicated by the widespread occurrence of ticks in that country that are resistant to the pesticides (acaricides) used to control them. ARS scientists at Kerrville, Texas, have developed improved diagnostic tests for tick resistance to pyrethroid and organophosphate pesticides. Discriminating dose-based bioassays for early detection of resistance are being used by APHIS to survey ticks on animals entering the U.S. from Mexico. In addition, DNA sequences of the sodium channel gene variant (responsible for resistance to pyrethroid) and acetylcholinesterase gene (resistance to organophosphate) have been determined. Work on development of DNA probes is in progress.

IMPACT/OUTCOME: This work provides APHIS with tools for early detection and control to prevent introduction of pesticide resistant ticks into the U.S. from Mexico.

STRATEGY 2.1.3: Germplasm resources and genomics: Acquire, preserve, evaluate, describe, and enhance genetic resources and develop new knowledge and technologies to increase the productive capacity and usefulness of plants, animals, and other organisms.

PERFORMANCE GOAL 2.1.3.1: Collections of well-documented germplasm of importance to U.S. agricultural security are readily available to scientists and breeders for research and development.

Indicators:

During FY 1999, ARS will

complete an extensive multi-year, multi-location evaluation of more than 500 different Chinese varieties of soybean for host-plant resistance to a variety of environmental extremes, pests, and pathogens. This knowledge and technology supported by ARS and a major commodity group will furnish genes to improve major oilseed and feed crops.

ACCOMPLISHMENTS: The evaluation of hundreds of Chinese soybean varieties is essentially complete. Molecular analyses indicated that Chinese soybean germplasm falls into three genetically different regional gene pools from Northeast, Central, and Southern China. These gene pools are genetically quite divergent from U. S. soybean germplasm. Germplasm was identified that has effective resistance to *Phytophthora*, a serious fungal disease; moderate resistance to soybean cyst nematode, the most serious U. S. soybean pest; and resistance to Mexican bean beetle, white mold, sudden death syndrome (caused by a fungus), brown stem rot, and root knot nematode. Derivatives from crosses of this germplasm with adapted U. S. varieties resulted in lines that equaled or out yielded standard U. S. varieties, indicating that the Chinese germplasm contained genes that enhanced yield.

IMPACT/OUTCOME: This research identified a broad spectrum of new genes and gene blocks from Chinese germplasm with substantial, short- and long-term potential impact on soybean profitability.

Because they originated from soybean, genes for resistance to important soybean pests and pathogens can be transferred into U.S. breeding populations by either conventional cross breeding or transgenic approaches. USDA/ARS, university, and corporate soybean programs are already incorporating the best of these materials into their breeding programs. Varieties derived from them may be available within the next five years.

conduct production-scale integrated disease control strategies that can be implemented to reduce losses caused by plant diseases.

ACCOMPLISHMENTS: The impending loss of methyl bromide for pre-plant soil fumigation is a serious threat to growers of many crops because of anticipated increased loss to disease. Integrated strategies involving time of planting, application of alternative chemicals, use of disease-resistant varieties, and improved cultural practices were tested on a commercial scale in grower production fields in California and Florida. Some treatments were found to be nearly as effective as methyl bromide fumigation.

IMPACT/OUTCOME: Practical and feasible alternatives to methyl bromide are critical to maintaining profitability for many crops and allowing growers to remain in business.

ACCOMPLISHMENTS: Combinations of crop rotations, improved irrigation technology, judicious use of pesticides, and resistant cultivars were effective for nematode control on several crops grown in the Southeastern United States. Cropping systems evaluated included cotton-peanut-soybean, cotton-peanut-rye, and wheat-cotton-peanut. Some of these systems resulted in reduced nematode populations and increased yields.

IMPACT/OUTCOME: These findings offer economical integrated cropping systems that will be needed to reduce costs and increase profits, especially if the expected withdrawal of currently used pesticides occurs.

make available to breeders germplasm contributing high fiber length and strength for incorporation in pima cotton breeding programs.

The work in this area is part of a broader effort which has been reported under Performance Goal 2.1.1.1.

release a new drought tolerant soybean variety for public use. The variety is expected to be planted on substantial "droughty" acreage in the Southeastern U.S.

ACCOMPLISHMENTS: ARS scientists discovered the first drought tolerant soybean type and have a breeding program underway to use this germplasm as a basis for developing high yielding, drought tolerant soybean varieties.

However, experimental lines and germplasm need additional testing before a variety is released.

IMPACT/OUTCOME: Drought is the greatest single limitation to soybean production. Development of improved drought tolerant varieties has the potential to greatly increase yields and improve farm income.

release a new soybean variety with improved oil quality. It is expected to have a high impact by gaining up to 50 percent of the cooking and frying oil market.

ACCOMPLISHMENTS: ARS scientists at Raleigh, North Carolina, have developed a new low linolenic soybean variety, "Soyola," that produces oil that does not require hydrogenation. Seed is expected to become available for production in 2001.

IMPACT/OUTCOME: Soybean oil is often hydrogenated to improve stability, but trans fatty acids are produced which have been implicated in cardiovascular disease. This new variety will provide vegetable oil processors with soybean oil that has better flavor, improved stability when used for frying, and without

transfatty acids. This is the first public release of a low linolenic soybean variety for the Southeastern U.S. soybean producing area.

begin studies using transgenic methods to incorporate antimicrobial disease resistant genes into crops (such as cottonseed) to protect pre-and postharvest seed products from microbial pathogens.

ACCOMPLISHMENTS: ARS researchers incorporated antifungal genes into cotton using genetic engineering. In preliminary tests, transgenic cotton was shown to contain antifungal activities in developing cottonseed within the cotton bolls.

IMPACT/OUTCOME: This accomplishment could greatly reduce losses in cotton yields due to fungal pathogens and reduce pesticide usage. Preliminary results indicated enough promise in the technology to warrant greenhouse testing of the cotton containing antifungal genes.

begin studies to exploit natural antifungal resistance mechanisms in corn kernels for protection of corn crops from pre- and postharvest attack by microbial pathogens.

ACCOMPLISHMENTS: Several resistance related proteins were identified in inbred corn varieties associated with corn kernels being highly resistant to fungal attack.

IMPACT/OUTCOME: Resistance proteins identified in corn kernels could lead to cloning genes that have the encoded proteins for use in genetic engineering or marker-assisted breeding of commercial corn varieties resistant to ear rotting fungi.

PERFORMANCE GOAL 2.1.3.2: Documented DNA base sequences of agricultural importance.

Indicators:

During FY 1999, ARS will, in conjunction with university, governmental, and seed company partners, initiate a broad-scale effort to sequence, map, and analyze publicly-available DNA clones for crops such as maize, rice, small grains, or soybeans. This research will focus especially on "expressed sequenced tagged" clones, which may provide information regarding genes for improving major grain, oilseed and feed crops.

ACCOMPLISHMENTS: ARS researchers at Albany, California, are producing some of the first publicly available nucleotide sequences for "expressed sequence tag" DNA (ESTs)--short yet diagnostic portions of genes--in this case, of wheat. They are also developing automated approaches to analyzing and storing these data. Other ARS researchers in Ames, Iowa, and their university collaborators are characterizing many ESTs from soybeans, and adding them to the soybean genome database. ARS researchers in Columbia, Missouri, are actively incorporating sequences of maize ESTs into the maize genome database.

IMPACT/OUTCOME: ARS scientists and their university and corporate partners have increased the scientific knowledge of crop genomes and constituent genes. This knowledge is furnishing crop geneticists and breeders worldwide with powerful new tools for crop improvement using agriculturally valuable genes that can be more readily identified, characterized, manipulated and transferred.

PERFORMANCE GOAL 2.1.3.3: Release of improved germplasm, varieties, and breeds based on effective use of genetic resources.

Indicators:**During FY 1999, ARS will**

introduce additional varieties of woody landscape plants, fruits, and vegetables with improved characteristics of pest and disease resistance and postharvest quality.

ACCOMPLISHMENTS: ARS scientists released a new ornamental cherry cultivar “Dream Catcher,” for early spring bloom that exhibits resistance to foliage diseases. This new cherry is being propagated for sale by nurseries and may replace older more susceptible cultivars.

Scientists released “Gulf Prince,” a new nonmelting variety of peach with improved shelf life. The nonmelting characteristic allows harvesting fruit near the time of maturity.

Nematode resistant populations of carrot for commercial development were released ARS.

IMPACT/OUTCOME: The cherry cultivar “Dream Catcher” is resistant to fungal pathogens which cause foliar diseases of cherry. It is expected to replace many older susceptible cultivars.

Development of nonmelting peach varieties will extend the useful life of peach crops and predictably increase market demand.

The introduction of genes for nematode resistance in carrots will reduce the need for soil fumigants and decrease costs of production.

release a white seedless grape that ripens at the end of the Thompson Seedless grape harvest season. The new variety will have a natural berry size as large as Thompson Seedless with gibberellic acid and a girdle. The new variety will reduce grower production costs and extend the grape production season.

ACCOMPLISHMENTS: A new mid-season seedless table grape cultivar, “Melissa,” has been released. “Melissa” produces large berries and ripens at the end of the Thompson Seedless season. “Melissa” responds to gibberellic acid to produce adequate thinning at bloom and increase fruit size at the time of berry set. Fruit holds well on the vine and in storage.

IMPACT/OUTCOME: This new grape cultivar will increase the supply and extend the season of white seedless grape production for U.S. consumers.

release a muscat flavored raisin grape with a fruitier flavor than any currently marketed. It will replace Muscat of Alexandria, a seeded muscat flavored raisin type grape. The new variety has potential for mechanical harvesting.

ACCOMPLISHMENTS: ARS scientists released “Summer Muscat,” a seedless muscat raisin grape for growers and nurserymen. This grape can be mechanically harvested, and eliminates the need for subsequent mechanical deseeding.

IMPACT/OUTCOME: Muscat flavored raisins are traditionally seeded and must be mechanically deseeded, resulting in a sticky, hard to manage product. Summer Muscat eliminates the need for deseeding. The availability of seedless Muscat varieties, such as Summer Muscat, is expected to rebuild the market for Muscat raisins.

release three forage soybean cultivars to commercial sources to fill a special niche for rapid, high quality forage production.

ACCOMPLISHMENTS: ARS scientists released three forage soybean cultivars, Donegal, Derry, and Tyrone, to provide livestock and dairy producers with sources of rapidly growing high protein forage. These are the first forage soybeans released by ARS. Commercial seed production by licensees provided seed for farmer production in 2000. The forage soybeans grow to six feet or more in height -- twice the height of ordinary soybeans and yield as much as six tons of dry matter per acre.

IMPACT/OUTCOME: These forage soybeans can reduce the production costs of dairy and livestock products, improve the efficiency of forage production, reduce the need for herbicides and insecticides and reduce soil erosion. Farmer interest in these forage soybeans has been described by individuals in the seed trade as "astounding."

PERFORMANCE GOAL 2.1.3.4: Improve methods for identifying useful properties of plants, animals, and other organisms, and for manipulating the genes associated with these properties.

Indicators:

During FY 1999, ARS will

identify and clone a gene responsible for pollen sterility in plants. This finding will encourage plant breeders to use a broader variety of genes for pollen sterility, thereby broadening the genetic base of the gene pools of major crops.

ACCOMPLISHMENTS: ARS researches in Albany, California, isolated and characterized three genes responsible for pollen grains being able to recognize the proper genetic type of plant for them to germinate and fertilize. Through genetic engineering, the function of one gene was disrupted, which conferred pollen sterility.

IMPACT/OUTCOME: This accomplishment represents an initial crucial step for enabling plant breeders to convert any fertile plant to a pollen sterile form. Once this approach is perfected, it will greatly increase the efficiency whereby plant breeders can breed and produce hybrid crops so that the yield boosting effects of heterosis are available to more of the world's farmers and crop processors.

conduct further testing under field conditions of the newly developed USDA 103 catfish strain to verify superior performance in commercial settings.

ACCOMPLISHMENTS: Field testing was performed at three locations using earthen ponds that verified superior performance of the USDA 103 catfish strain.

IMPACT/OUTCOME: Over 1.2 million catfish are being raised as brood fish for planned germplasm release. Shortly, catfish producers will have a new strain of catfish (USDA 103) that was selected for faster growth, improved reproductive success, and greater disease resistance.

conduct test runs on the "Test Day Model" for the genetic evaluation of the U.S. dairy herd.

ACCOMPLISHMENTS: Test runs for the "Test Day Model" were conducted on schedule with satisfactory results. The model will be implemented as a component of the national Dairy Cattle Genetic Improvement Program in FY 2000.

IMPACT/OUTCOME: The "Test Day Model" will improve the accuracy of genetic evaluation of milk production traits, and thereby increase the profitability of the dairy industry.

STRATEGY 2.1.4: Plant and animal biological processes: Develop biologically based technologies to improve productivity, safety, nutrient content, and quality of plants, animals, microbial organisms, and their products.

PERFORMANCE GOAL 2.1.4.1: Make technologies available for improving productivity, safety, quality, and the security of the agricultural production system.

Indicators:

During FY 1999, ARS will

conduct research leading to registration of a second therapeutic compound useful for treating diseases of farm-raised fish.

ACCOMPLISHMENTS: A human food safety report was submitted to the FDA on the use of copper sulfate as a fish disease therapeutant. Residue studies showed no change in the copper content of edible filet tissue. Additional data have been submitted documenting that copper sulfate has a minimal effect on the environment when properly used as a treatment for disease.

IMPACT/OUTCOME: When the registration process is complete, fish farmers will have an approved health management treatment against ichthyophthiriosis, a disease that causes economic losses of fish.

*actively incorporate the *Cercospora* tolerance gene discovered and developed by ARS into several commercial breeding programs to produce *Cercospora*-resistant crop plants.*

Research has not yet been done. Gathering information on genetics and mode of action.

complete development and testing of a modified, live vaccine to prevent enteric septicemia of catfish, the leading cause of economic loss to the catfish industry. A CRADA partner will seek approval from APHIS for a commercial license to manufacture this vaccine.

ACCOMPLISHMENTS: The modified live *Edwardsiella ictaluri* vaccine was demonstrated to be safe for vaccination of 7 to 10 day old catfish fry under experimental practices.

IMPACT/OUTCOME: The biosafety data was transferred to Intervet, Inc., the CRADA partner, which was used in its application to APHIS for licensing of the vaccine. The vaccine is to be available to farmers in the year 2000.

locate, clone, and begin to sequence mutant genes that promote degreening of maturing seeds. These genes, when transferred into canola plants, will contribute to solving a problem of loss of oil quality when the harvest includes some green immature seeds.

ACCOMPLISHMENTS: Degreening is disrupted by cold temperatures. In 1999, a sensitive new assay was developed to identify products of chlorophyll degradation which was used to identify the specific step in the degreening process that is sensitive to frost. This knowledge is the basis for identifying and isolating the gene responsible for degreening failure.

IMPACT/OUTCOME: Green canola seeds at maturity are a \$150 million problem to North American growers. If the seeds fail to degreen, then the color must be removed from the oil later at great expense or else the seeds are worthless. Frost interferes with the degreening process by affecting some specific steps in the biochemical process by which chlorophyll is destroyed. Research in ARS is identifying those genes sensitive to frost, so that they can be replaced with more frost tolerant genes. Canola is an

important oilseed crop which is expanding rapidly because its oil has healthful properties compared to some other cooking oils commonly used.

continue to develop applications of the patented technology protection system that prevents seeds from being reproduced. Efforts will concentrate on cotton to add value and safety to proprietary genetically engineered varieties. The Agency's CRADA partner will have the right of first refusal of an exclusive license.

ACCOMPLISHMENTS: The three different genes of the Technology Protection System were combined in cotton for the first time, so that the complete system assembled in one plant can be tested. Proposals for other applications of the patented gene regulatory system were developed, and several of the most promising were recommended for further research.

IMPACT/OUTCOME: The Technology Protection System is a revolutionary new means of controlling gene expression in plants with many possible applications. One of the possible applications, which was developed by cooperative work with a seed company and received considerable attention is seed sterilization. There are many other potential applications that promise to be extremely beneficial to agriculture. Areas of possible application include improved forage quality for dairy cattle, improved structures of "refuges" for pest resistance management in transgenic insect resistant crops, and decreased use of defoliant chemicals on cotton.

develop precision maps of in-field variation in cotton fiber quality and relate the variability to soil properties and conditions. This will allow growers to identify the sites that produce the highest and lowest quality cotton and to devise management schemes accordingly.

ACCOMPLISHMENTS: Mapping fiber maturity in the field showed a positive relationship between maturity and soil phosphorus, and also between maturity and soil organic matter. In addition, uniformity of fiber properties is related to how cotton bolls are distributed on the plants which is relatively simple to assess. Integrated maps of fiber quality in the field indicate that zoned harvesting to separate the better fiber from the poor during harvest is possible.

IMPACT/OUTCOME: Cotton fiber varies widely in its properties which puts it at a competitive disadvantage compared with synthetic fibers like polyester. Cotton mill operators need better information about the properties of the cotton they purchase, and more importantly, need a more uniform product. Some lack of uniformity arises from nonuniform field growing conditions. The degree to which this contributes to other problems has not been carefully analyzed. This research has shown that it is possible to map fiber quality attributes according to location within the field. It seems feasible to use precision agriculture techniques to harvest good fiber separately from poor fiber. The exact value added by separate harvests has not yet been tested.

continue to develop sustainable and organic farming strategies to control exotic weeds.

ACCOMPLISHMENTS: ARS is increasing its research in support of organic farming. For example, a detailed assessment of weed problems facing organic farming is being conducted in the Buckeystown, Maryland, area with three key organic farmers. A similar assessment is planned for Salinas, California. It should be noted that all of the ARS biologically-based, nonchemical weed research (e.g., biological control and cultural control) is applicable to small farms and organic farms.

IMPACT/OUTCOME: The organic farming industry rated weed management as its top priority. These investigations will help quantify the nature and distribution of weeds that impact organic farming, and (particularly with appropriate new funding) will lead to development of weed management strategies for organic farms in the future.

OBJECTIVE 2.2: Safe food: “Maintain a ... safe supply of food to meet human ... needs”

STRATEGY 2.2.1: Plant and animal product safety: Provide knowledge and means for production, storage, and processing of safe plant and animal products.

PERFORMANCE GOAL 2.2.1.1: Transfer knowledge developed by ARS to industry and regulatory agencies.

Indicators:

During FY 1999, ARS will

report a new strategy to develop wheat that is resistant to wheat head scab, a disease that causes yield losses and results in the presence of toxins in wheat products. ARS researchers have identified a key gene that confers fungi of the genus fusarium with tolerance to their own toxins. Previously, researchers identified the toxins as key players in the disease process in plants. The gene has successfully been transferred to a yeast strain where it also confers protection. Work is underway to transfer the gene into a model plant and establish how the gene works. If it offers protection to plants from fungal invasion and toxin accumulation, it could be incorporated into wheat germplasm.

ACCOMPLISHMENTS: ARS has developed a new strategy to produce wheat lines that are resistant to wheat head scab, a disease caused by fusarium fungi which causes yield losses and can result in the presence of toxin in wheat and barley products. Research also has identified key genes that confer fungi of fusarium with tolerance to their own toxins. These genes, TRI 101 and PDR5, have now been placed in tobacco and the transformed plants have been shown to have greater resistance to wheat head scab. These two genes have also been successfully transformed into wheat and barley, and the transformed plants are currently being evaluated in wheat and barley to determine if the gene is expressed and effective.

IMPACT/OUTCOME: These genes can potentially result in wheat and barley that is resistant to wheat head scab, thus protecting the food supply from an important toxin which results in greater returns to producers.

identify the common sources of salmonella and campylobacter in poultry. The poultry industry will then be able to better target intervention strategies to prevent the occurrence of these human pathogens in all segments of the industry.

ACCOMPLISHMENTS: ARS has completed a preliminary epidemiology study encompassing both production and processing operations that targeted two common poultry epizootic pathogens of poultry, salmonella and campylobacter. The production control points targeted by the results are hatching cabinet disinfection, consistent use of new paper pads for newly hatched chicken, competition exclusion, and litter treatments in the production house. The reduction of pathogens during processing appeared mostly related to plant use of chlorine during chilling.

IMPACT/OUTCOME: The data from poultry farms in five States will enable ARS to plan a commercial scale trial to examine the four implicated production control points to further reduce the levels of pathogens on poultry beyond what can be achieved by increased chlorine use during processing. The information will also identify the most effective producer practices that can further improve the safety of poultry for human consumption.

provide model appropriate pathogen limits at each established critical control point in the swine slaughter process at a commercial meat processing plant under a Memoranda of Understanding. This work will be

a model on how to assure that the final pork products meets the standards and guidelines of the HACCP plan required by FSIS.

ACCOMPLISHMENTS: ARS studies were conducted at the Hatfield swine processing plant in Pennsylvania. Samples were taken at all critical control sites during the animal slaughter and carcass dressing process. The most important finding was: that bacterial numbers were significantly reduced on the carcass during slaughter, specifically from the singeing process. However, the final washer/polisher recontaminated the carcass prior to evisceration and chilling. Bacterial levels during evisceration remained essentially unchanged, while there was a further small decline in viable numbers of bacteria during the chilling operation. With the approval of the FSIS, the final washer/polisher was taken off line, which resulted in a microbiologically clean carcass.

IMPACT/OUTCOME: The research indicated that a visually clean carcass does not necessarily translate to a microbiologically clean carcass. Singeing is a significant critical control point early in the slaughter process, while thorough cleaning and sanitation and removal of the second washer/polisher is a critical control point late in slaughter. Implementation of ARS recommended changes in the slaughter process at Hatfield has resulted in a significant decrease in contaminated carcasses, to a near zero level. The Hatfield plant is now considered the “standard” for swine processing.

*in cooperation with partners, perform aflatoxin resistance trials at multiple locations using corn varieties demonstrated to have specific structural, chemical or biochemical mechanisms of resistance to *Aspergillus flavus* and aflatoxin. Diagnostic methods will be developed that enable breeders to monitor the transfer of resistance factors into commercial hybrids. Identification of relevant corn resistance factors is based on years of fundamental research on ecology, pathology, and epidemiology of the fungus as well as critical observations of varietal resistance/susceptibility in corn lines.*

ACCOMPLISHMENTS: Aflatoxin resistance trials in the laboratory and field locations have identified corn varieties that have specific structural, chemical, or biochemical mechanisms of resistance to *Aspergillus flavus* and aflatoxin. Further, the research has identified regions on the corn chromosomes associated with aflatoxin resistance.

IMPACT/OUTCOME: Identification of these regions of the corn chromosomes critical to aflatoxin resistance will enable breeders to more easily monitor the transfer of resistance into commercial high yielding hybrids. In turn, this will provide the basis for more rapid development of aflatoxin resistant corn varieties that will protect the public health and provide greater return to producers.

publish information on the effects of drought tolerance in peanut varieties.

ACCOMPLISHMENTS: Drought tolerant peanut genotypes have been developed by selecting for larger root systems. These genotypes have recently been shown to have less aflatoxin contamination than standard varieties when subjected to heat and drought stress. This information has been published.

IMPACT/OUTCOME: Improvements in resistance to aflatoxin would save the U.S. peanut industry millions of dollars in losses due to this toxin.

GOAL 3: A Healthy and Well-Nourished Population Who Have Knowledge, Desire, and Means to Make Health Promoting Choices.

Analysis of Results: This goal is the focus of much of ARS’ research related to human nutrition and health. Under Goal III, 11 Indicators are aligned under 3 Performance Goals. Because of the unique and dynamic nature of research, several Indicators were added to the Report that did not first appear in the Annual Performance Plan for FY 1999. This was done to ensure that significant accomplishments that

were not anticipated last year were reported. While it is not possible to report research accomplishments numerically, the progress projected in all 11 Indicators was completed or substantially completed during FY 1999.

OBJECTIVE 3.1: Nutritious food: "Maintain an adequate and nutritious ... supply of food to meet human nutritional needs and requirements."

STRATEGY 3.1.1: Human nutrition requirements: Determine requirements for nutrients and other food components of children, pregnant and lactating women, adults, and elderly of diverse racial and ethnic backgrounds.

PERFORMANCE GOAL 3.1.1.1: Indicators of function determined and related to diet and health.

Indicators:

During FY 1999, ARS will

determine the role of various nutrients in providing maximum health benefits to the population, including children and the elderly. This information is needed to develop meaningful dietary recommendations for individuals throughout the life cycle.

ACCOMPLISHMENTS: A number of projects were completed addressing the role of various nutrients in providing maximum health benefits to the population throughout the life cycle. ARS researchers found that:

Vitamin K may be a modifiable risk factor for osteoporosis.

In a randomized trial examining the effect of a multivitamin/mineral supplement on nutritional status, immune responses, and plasma homocysteine in older adults with moderately elevated homocysteine levels: among apparently healthy and well nourished older adults, and subsequent to the mandated fortification of flour with folic acid, RDA levels of supplementation significantly increased micronutrient status and lowered total plasma homocysteine, an independent risk factor for heart disease.

The intake of vitamin E contributes to reducing the risk of atherosclerosis and cancer through modulation of immune and endothelial cell interaction, production of several chemokines, proinflammatory cytokine IL-6, and modulation of angiogenesis.

In older men and women smokers, less efficient calcium absorption is one mechanism by which smoking accelerates bone loss.

One mechanism by which dietary saturated fat and cholesterol decreases HDL apoA-I is the restriction of these constituents in the diet which lowers LDL cholesterol and LDL apoB by enhancing its fractional clearance via the LDL receptor mediated catabolism. The predominant reason that HDL apoA-I is decreased with such diets is because of decreased production.

One benefit of maintaining a diet rich in vitamin C (antioxidants) early in life may be to limit the risk for eye disease later in life.

Nutritional deficiencies that affect nerve function, such as B12 and thiamine, may alter nerve muscle interactions and affect sarcopenia.

A new cultivar of high soluble fiber barley was more effective than oats in reducing both glucose and insulin response.

Chromium may be involved in the control of blood sugar levels in people with glucose intolerance and diabetes.

Factors in soy protein isolate, the sole protein source of most soy infant formulas, can reduce the incidence of breast cancer and colon cancer and can improve metabolism.

Iron stores are a primary determinant of the amount of manganese absorbed from a meal, but retention of manganese was regulated independently of absorption by means of variable excretion. Thus, there is a need to consider the iron stores of humans when attempting to determine the optimal intake of manganese.

Glycation, the undesirable binding of sugar to proteins, is enhanced by dietary copper deficiency. Because glycation is a process that is increased in diabetes and aging, this finding suggests that reduced copper intake may worsen the consequences of these two conditions.

Nickel is homeostatically controlled by absorption and retention processes, and that tissue nickel is metabolized by at least three different mechanisms.

Changes in dietary fat can modify mineral metabolism.

People with adequate iron stores do not fully adapt to prevent increased iron stores with supplementations, but women with low iron stores may need continuing iron supplementation to counterbalance high rates of iron excretion.

Moderately low folate levels adversely affects blood homocysteine levels and DNA composition.

Adequate iron status is required to maintain optimal cognitive performance on attention-based tasks in both men and women.

Cellular content of lycopene and other tomato-related carotenoids can be increased through intake of tomato products.

IMPACT/OUTCOME: Findings from these studies add to the body of knowledge on the role that nutrition has in maintaining and improving health. Many of these findings result in scientific recommendations which may lead to changes in dietary recommendations and nutrition policy which affect food assistance programs.

continue to define the relationship between nutritional status of a host and the ability of viruses to change their virulence and cause infection by studying the variety of nutrients that might be involved and determining the viral agents that might be similarly affected. This information is needed to determine the role of nutrition in understanding viral pathogens known to cause disease in humans.

ACCOMPLISHMENTS: It has been demonstrated that a gold compound known to act as a metabolic antagonist of selenium caused a benign coxsackie virus to exhibit virulence. The research was expanded to determine whether other selenium antagonizing heavy metals of ecological interest might behave similarly, such as mercury or arsenic. The results showed that the pathogenicity of the virus can be influenced not only by the nutritional status of the host but also by the exposure of the host to various toxic environmental contaminants.

IMPACT/OUTCOME: The economic loss to the Nation due to illnesses caused by infection is staggering. Little is known about the role of the nutritional status of the host. A long series of investigations have led to the realization and understanding that a diet inadequate in antioxidants renders an organism vulnerable to numerous pathological changes. These studies have shown that dietary oxidative stress increases viral virulence apparently by changing the genetic nature of the virus as it replicates within the host.

use molecular biology to determine how nutrients and other dietary constituents act to turn on the synthesis of the proteins required for their metabolism and use in the body. With this information, meaningful dietary advice can be formulated for individuals who are at increased risk for particular diseases.

ACCOMPLISHMENTS: ARS scientists demonstrated that a common vitamin D receptor genotype in premenopausal women is not related to bone density. The genesis of genotype specific difference in bone mineral density is likely to reside elsewhere.

Researchers also demonstrated the role for the enzyme, lipoprotein lipase (LPL), in the tissue uptake of dietary vitamin A using gene knockout and transgenic systems.

Researchers found that copper deficiency during pregnancy suppresses the expression of protein kinase C-gamma in the cerebella of female neonates to a much greater extent than in the cerebella of male neonates. Since protein kinase C expression regulates brain development, the present findings are significant because they indicate that copper deficiency targets the cerebellum as a region of the neonatal brain where development is impacted through the suppression of protein kinase C gamma.

IMPACT/OUTCOME: Understanding the basic mechanisms of the metabolic process is important for developing potential targets for nutritional interventions.

STRATEGY 3.1.2: Food composition and consumption: Develop techniques for determining food composition, maintain national food composition databases, monitor the food and nutrient consumption of the U.S. population, and develop and transfer effective nutrition intervention strategies.

PERFORMANCE GOAL 3.1.2.1: Transfer new measurement techniques and data to users, release results of surveys, and disseminate effective nutrition intervention strategies.

Indicators:

During FY 1999, ARS will

provide information to the EPA and the public related to food consumption patterns of children for use in developing estimates of usual daily intake. This information is needed by EPA to develop regulations on the allowable intake of pesticides in foods as required by the Food Quality Protection Act.

ACCOMPLISHMENTS: Data collection was completed for the Supplemental Children's Survey to the Continuing Survey of Food Intake by Individuals (CSFII) 1994-1996. Dietary data were collected from over 5,200 children from birth through nine years of age.

IMPACT/OUTCOME: The CSFII provides the data needed to monitor and assess food consumption in a very select group of individuals, children.

complete a pilot project to test the feasibility of using telephone technology to conduct food intake surveys. If successful, it will help reduce the cost of conducting food consumption surveys such as the CSFII.

ACCOMPLISHMENTS: Food intake by individuals in telephone and nontelephone households, interviewed in person or by telephone, was reported not to be different.

IMPACT/OUTCOME: The present study demonstrates that telephone conducted 24 hour dietary recall interviewing is a valid method for collection of food intake information in the rural Delta of Arkansas, Louisiana, and Mississippi.

continue to develop methods of analysis that will be useful in the determination of a variety of phytonutrients in foods in order to develop a database of such information to allow for epidemiological studies of the relationship between the phytonutrients and the incidence of diseases such as heart disease and cancer.

ACCOMPLISHMENTS: A robust high performance liquid chromatography system was developed that separates and quantifies about 20 flavonoids in less than an hour.

IMPACT/OUTCOME: In collaboration with Iowa State University, a database on the isoflavone content of soybeans and soy-based foods was assembled and released on the web (www.nal.usda.gov/fnic/foodcomp). This database will permit health professionals to determine associations between the intake of isoflavones and health status in U.S. populations and subpopulations.

define, as part of the Lower Mississippi Delta Research Initiative, the nutritional status of individuals living in the Lower Mississippi Delta and begin to measure changes in that status as intervention strategies are implemented.

ACCOMPLISHMENTS: Consumption of high fat foods and fast foods were identified as the most important nutrition problems, and hypertension and teen pregnancy as the most important health problems. Multiple contributing factors to health and nutrition problems were poverty, lack of exercise, lack of nutrition and health knowledge, and inadequate health insurance. Race was significantly associated with perceptions, particularly those factors contributing to problems.

IMPACT/OUTCOME: Key informants agreed upon the most important nutrition and health problems in their communities and identified multiple contributing factors. Perceptions were consistent with prevalence data for the region.

maintain and expand the database of the nutrient content of foods in order to understand which food choices result in a healthy diet. An accurate database is essential for making dietary recommendations since it is necessary to know with certainty what nutrients are contained in particular foods.

ACCOMPLISHMENTS: The Nutrient Database for Standard Reference (SR), Release 13, was developed and is scheduled for release in December 1999.

IMPACT/OUTCOME: SR13 will provide estimates of composition for up to 82 components and 6,210 foods. SR 13 will be available on the web (www.nal.usda.gov/fnic/foodcomp).

STRATEGY 3.1.3: Nutritious plant and animal products: Develop more nutritious plant and animal products for human consumption.

PERFORMANCE GOAL 3.1.3.1: Demonstrate improved nutritional quality.

Indicators:

During FY 1999, ARS will

determine the nutritional quality of various kinds of commodity products and foods consumed. This is an ongoing process to include new and ever changing nutritional data in the National Nutrient Database.

ACCOMPLISHMENTS: As part of the National Food and Nutrient Analysis Program, the following objectives have been met: application of a statistically-based conceptual framework for the selection of representative samples of the food supply; development of unique sampling plans for specific foods and

nutrients; and chemical analysis of food samples for nutrient content under rigorous quality control programs.

ARS scientists also developed:

In collaboration with Perkin-Elmer Corporation, a new atomic absorption spectrometer that provides more accurate determinations of trace metals in foods.

A new method for the analysis of the carotenoid content of fruits, vegetables and other foods which can replace the traditional long high performance liquid chromatography system.

A more refined and robust method to determine resistant starch.

A robust system for the extraction and analysis of individual naturally occurring folates and folic acid which is added to many foods.

IMPACT/OUTCOME: Food composition data that reflects current commodity products and foods consumed is important in assessing nutritional quality and its role in a population's health status.

examine hybrid plants with increased mineral content which may have beneficial effects on human health.

ACCOMPLISHMENTS: A group of zinc inefficient mutants in the model plant, *Medicago truncatula*, that exhibit symptoms of zinc deficiency when grown on normally adequate zinc concentrations was investigated. Studies have shown that these plants are not limited in their ability to absorb zinc, since the leaves will exhibit symptoms of deficiency even when total leaf zinc levels are comparable to those of nonmutant control plants.

IMPACT/OUTCOME: These mutants will serve as useful tools to determine how zinc nutrition is regulated within crop plants.

determine bioavailability of essential nutrients in plant foods selected for improved nutrient density. Consumption of foods with increased amounts of certain nutrients has potential for their beneficial effects on human health.

ACCOMPLISHMENTS: ARS scientists demonstrated that iron uptake by intestinal epithelial cells is enhanced by factors in meat. Complete identification of this so-called "meat factor" may lead to the development of improved dietary iron supplements and contribute to improved nutritional health because of improved iron bioavailability.

ARS researchers also showed that:

Tomato carotenoids phytofluene and phytoene are much more bioavailable than would be expected based on their content in tomato products.

Molybdenum was highly available from kale, but less available from soy. The results show that the bioavailability of molybdenum must be taken into account when establishing dietary recommendations.

IMPACT/OUTCOME: Ways to identify active forms of nutritionally important plant-based compounds and determine the efficacy of absorption and utilization of them on nutritional health is important. Several health problems may be caused by either trace mineral deficiencies or lack of adequate consumption of dietary components that may be beneficial to human health. Some of these problems can be ameliorated by consumption of foods with increased amounts of specific bioavailable nutrients.

GOAL 4: To Enhance the Quality of the Environment Through Better Understanding of and Building on Agriculture's and Forestry's Complex Links with Soil, Water, Air, and Biotic Resources.

Analysis of Results: This goal is the focus of much of ARS' research on a wide range of environmental issues related to agriculture. Under Goal IV, 42 Indicators are aligned under 18 Performance Goals. Because of the unique and dynamic nature of research, several Indicators were added to the Report that did not first appear in the Annual Performance Plan for FY 1999. This was done to ensure that significant accomplishments that were not anticipated last year were reported. While it is not possible to report research accomplishments numerically, the progress projected in 41 Indicators was completed or substantially completed during FY 1999. One Indicator was not successfully completed and the report explains the reasons.

OBJECTIVE 4.1: Balance agriculture and the environment: "Increase the long-term productivity of the United States agriculture and food industry while maintaining and enhancing the natural resource base on which rural America and the United States agricultural economy depend."

STRATEGY 4.1.1: Natural resource quality: Develop new concepts, technologies, and management practices that will enhance the quality, productivity, and sustainability of the Nation's soil, water, and air resources.

PERFORMANCE GOAL 4.1.1.1: Demonstrate concepts and on-farm agricultural technologies and management practices that maintain and enhance the environment and natural resource base.

Indicators:

During FY 1999, ARS will

provide assessment tools to NRCS and land managers to quantify soil and water quality assessments that will enable land managers to evaluate current practices. If current agricultural technologies and practices degrade the soil or water resources, more sustainable management practices will be recommended.

ACCOMPLISHMENTS: ARS scientists in Corvallis, Oregon, in cooperation with personnel from the NRCS, completed a demonstration version of the Crop Rotation Economic and Environmental Impact Decision Aid. It helps land managers make informed decisions regarding cropping systems, maximizing profitability, and minimizing adverse impacts on the environment.

IMPACT/OUTCOME: Initial results from the demonstration version showed the ecological and economic advantages of using no-till technology on steep Oregon farmlands and employing minimal soil surface disturbance strategies for planting and harvesting forages. These results will specifically impact land managers in Oregon by maximizing productivity and minimizing soil loss due to erosion. These impacts will apply on a broader level when the tool is used by land managers.

ACCOMPLISHMENTS: ARS scientists developed tools and approaches for soil quality assessment including a soil quality test kit, a manual for the test kit, and a book, "Methods for Assessing Soil Quality."

IMPACT/OUTCOME: These tools were transferred to the NRCS. Over 5,000 copies of the manual were distributed to NRCS field offices. The tools are being used by NRCS, producers, scientists, conservationists, and educators to assess the sustainability of agricultural management practices.

ACCOMPLISHMENTS: A prototype version of the Nitrogen Leaching Economic Analysis Package with a JAVA interface has been delivered to NRCS field offices. ARS and NRCS cooperatively developed a continuous version of the Agricultural Non-Point Source (AGNPS), which is a practical model that is being used by NRCS to evaluate water quality control practices within large watersheds.

IMPACT/OUTCOME: NRCS field offices will use these tools to address water quality and global warming issues.

beta test a model for predicting PM-10 dust concentrations in the Eastern Washington area plus a module for a similar purpose within a wind-erosion prediction system that is under development for application nationwide.

ACCOMPLISHMENTS: An empirical wind erosion and dust emission model was completed by scientists in Pullman, Washington. This model allows regional dust emission estimates.

IMPACT/OUTCOME: Computations using this dust emission model provide knowledge for regional air quality agencies about the relative severity and general locations of dust emissions and expected impacts downwind in urban areas. The agency officials were able to develop a regional policy on wind erosion hazards and future practices to reduce these impacts.

determine the effectiveness of flocculants in reducing the transport of weed seeds, microbes, and pathogens in irrigation runoff water. Successful development of this technology will reduce the use of algicides, fungicides, and herbicides to control these biological organisms, thereby reducing the presence of these chemicals in the environment.

ACCOMPLISHMENTS: Scientists produced Polyacrylamide (PAM), which has been shown to improve water infiltration, prevent runoff, nearly eliminate erosion, and reduce chemical losses from irrigated land. Compared with conventional furrow irrigation, PAM-managed irrigation eliminates over 90 percent of runoff soil losses. Migration of microorganisms and transfer of weed seeds are greatly reduced. PAM is being promoted by NRCS and other Federal and State agencies for farmer use, and for erosion control from construction sites. About one million acres of irrigated farmland were protected from erosion using PAM in 1998.

IMPACT/OUTCOME: PAM reduces the spread of weeds and diseases and results in reduced need for pesticide application which improves surface water quality.

in cooperation with the NRCS and other Federal agencies, publish restoration guidelines and recommended practices in a new Stream Corridor Restoration Handbook. This will assist implementation of the Clean Water Action Plan, which is designed to create two million miles of buffer zones adjacent to waterways by 2002, construct 100,000 acres of wetlands by 2005, and restore 25,000 miles of stream corridors by 2005.

ACCOMPLISHMENTS: The manual, "Stream Corridor Restoration: Principles, Processes, and Practices," was published in October 1998, and updated in November 1999 by the Federal Interagency Stream Corridor Restoration Working Group. The manual is used by those interested in restoring the functions of the Nation's stream corridors.

IMPACT/OUTCOME: Forty-four percent of the rivers in the United States are degraded by sedimentation and excess nutrients. This manual is for managers trying to restore rivers to be used for drinking water, fish and wildlife habitat, recreation, agriculture, and flood prevention.

expand work on integrated livestock management systems that are needed for U.S. producers to compete successfully in meeting the food requirements of an ever increasing world population while managing waste problems to avoid adversely impacting air and water quality.

ACCOMPLISHMENTS: ARS scientists in the Nutrition Research Unit, Clay Center, Nebraska, demonstrated that essential oils of two plants inhibited fermentation, odor emission, and pathogens when used at low levels with manure. Further evaluation under field conditions will be initiated.

IMPACT/OUTCOME: While preliminary results are promising, it is too early to determine whether the compounds will have application to solving odor and nutrient conservation problems in production facilities.

develop livestock and poultry diets and feed additives that increase nutrient utilization efficiency by the animals, thus protecting the environment by reducing nutrients excreted.

ACCOMPLISHMENTS: Ineffective use of phytic acid forms of phosphorus in grain by monogastric animals such as poultry and swine has resulted in excessive levels of phosphorus in manure. ARS scientists have developed corn with lower levels of indigestible phytic acid without reducing total phosphorus.

IMPACT/OUTCOME: Poultry fed this low phytic acid corn used phosphorus in the grain more effectively and produced manure with 25 to 40 percent less phosphorus than poultry fed a diet of regular high phytic acid corn. The technology has been licensed to corn seed producers who are breeding the trait into elite corn lines. Commercial hybrids may be ready for release within two to three years.

PERFORMANCE GOAL 4.1.1.2: Experimentally demonstrate the appropriateness of watershed-scale technologies and practices that protect the environment and natural resources.

Indicators:

During FY 1999, ARS will

develop a reliable scientifically defensible decision making tool to assist farmers and natural resource agencies in developing nutrient management plans for phosphorus and animal manure applications. The NRCS and farm consultants will be able to use this scientific aid to determine manure application rates based on soil phosphorus levels and a crop's phosphorus requirements. These recommendations will benefit State regulatory agencies in areas where expanding confined animal operations cause concern for potential water quality degradation.

ACCOMPLISHMENTS: Researchers at University Park, Pennsylvania, showed that more than 90 percent of the soluble phosphorus exported annually from an agricultural watershed in the Chesapeake Bay Basin came from less than 10 percent of the watershed area in a few large storms. A simple indexing tool, P Index, has been developed to identify and rank the vulnerability of soils, landscapes, and management practices to phosphorus loss in runoff. Researchers at several ARS laboratories (Bushland, Texas; Beltsville, Maryland; and University Park, Pennsylvania) have shown that phosphorus solubility in high phosphorus soils can be reduced by application of readily available low cost materials such as coal combustion byproducts, water treatment residuals, and caliche. These materials reduce soluble phosphorus moving to surface water in runoff but do not reduce crop yields.

IMPACT/OUTCOME: The P Index is now being used by the NRCS to identify sensitive areas and target management alternatives to reduce the phosphorus loss.

release an interactive six year database from the Midwest Management Systems Evaluation Area (MSEA) project on alternative cropping practices and systems that can be used by NRCS and the EPA to promote the use of practices that reduce nonpoint source pollution of surface and ground waters. The Clean Water Action Plan calls for more than \$120 million in new assistance to States and tribes to curb polluted runoff and encourage the adoption of enforceable State and tribal controls.

ACCOMPLISHMENTS: ARS will release the full six year database from 10 sites within the Midwest MSEA project in early 2000.

IMPACT/OUTCOME: The data will be widely used to develop management practices that will reduce runoff from agricultural sources resulting in cleaner water.

support the Presidential Environmental Initiative for Watershed Health/Pfiesteria research to determine the potential role of agricultural nutrients in the degradation of the Chesapeake Bay and other waterways.

ACCOMPLISHMENTS: A modeling technique was developed to identify areas in a watershed that would contribute runoff to surface water bodies. When high surface runoff potential is combined with high soil phosphorus concentration, significant amounts of this nutrient can be transported to surface water during storm events. Studies within agricultural watersheds in the Chesapeake Bay Basin indicated that more than 90 percent of soluble phosphorus transported annually to surface water comes from only 8 percent of the land area in a watershed during a few large storms.

IMPACT/OUTCOME: These methods should allow identification of areas within a watershed that are vulnerable to nutrient losses. Producers can then protect water quality by directing appropriate management practices to a small fraction of their land area.

conduct agricultural research in support of the South Florida ecosystem restoration to maintain sustainable agricultural production, environmental quality, and reduce the spread of the Melaleuca tree.

ACCOMPLISHMENTS: ARS scientists have made significant progress toward the development of the Everglades Agro-Hydrology model. A second biological control, the sawfly *Lobhyrotoma Zonalis*, will soon be released to complement the highly successful oxyopus snout beetle in the control of the Melaleuca tree.

IMPACT/OUTCOME: Reduced environmental impacts of agriculture in the South Florida ecosystem will provide producers and residents of the area with more productive agriculture and a preserved habitat for recreation and posterity.

STRATEGY 4.1.2: Global change: Increase understanding of the responses of terrestrial ecosystems to manmade and natural changes in the global environment.

PERFORMANCE GOAL 4.1.2.1: Documentation of agriculture's effects on the global environment.
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Indicators:

During FY 1999, ARS will

continue efforts with its cooperators to document the exchange of carbon dioxide between grasslands and the atmosphere at 12 locations across the central and western U.S. to provide data critical to assessments of agriculture's role in climate change and for making accurate predictions of its future impacts on global warming. This data is important for updating general circulation models currently used for predicting global climate changes.

ACCOMPLISHMENTS: Carbon dioxide fluxes above typical grasslands scattered throughout the Central and Western U.S. have now been monitored through a growing season and in some cases a year long at 12 locations using Bowen ratio micrometeorological methods. In addition, clear plastic chambers were used at several locations to validate the Bowen ratio measurements and document the effects on fluxes of specific grassland management practices.

IMPACT/OUTCOME: These data are important in assessing agriculture's role in climate change and making accurate predictions of agriculture's impacts on global warming. At some locations, undisturbed grasslands proved to be significant carbon sinks by accumulating 0.4 to 1.0 kilograms of carbon per

hectare per year, meaning that carbon was not “lost” to the atmosphere. A single, highly productive tall grass prairie site in the Southern Great Plains appeared to have an average annual carbon storage rate of three kilograms of carbon per hectare per year. When carbon dioxide is released into the atmosphere, it is considered a greenhouse gas that contributes to the phenomena known as climate change. The data from these 12 ARS locations will help document agriculture’s positive impact on climate change.

document amounts of greenhouse gas emissions from livestock waste lagoons and the conditions conducive to their production and release to the atmosphere, enabling specific procedures to be proposed and evaluated for reducing or eliminating emissions.

ACCOMPLISHMENTS: A major challenge of manure management is to minimize ammonia losses, which have potential short- and long-term effects on the surrounding environment. ARS scientists measured emissions of ammonia, methane, and nitrous oxides from swine facilities, waste lagoons, and the effluent applied to land. Ammonia emissions from lagoons varied diurnally and seasonally, and were related to lagoon ammonia concentration, acidity, temperature, and wind turbulence. Measurements over a three year period indicated that ammonia emissions were far less than expected since a significant amount of ammonia in the lagoons was converted to harmless nitrogen gas.

IMPACT/OUTCOME: These investigations provided State and Federal regulatory agencies with realistic emission data factors for ammonia, methane, and nitrous oxides. These results also suggested that waste management systems can be manipulated to reduce ammonia emissions and maximize nitrogen gas emissions.

determine the sources and rates of greenhouse gas emissions from crop, forage, and livestock production systems.

ACCOMPLISHMENTS: Anaerobic lagoons are considered to be sources of greenhouse gases (methane and nitrous oxide) implicated in global warming and are potential air and water pollutants. ARS scientists produced statistical models that account for up to three-quarters of the variability in the emissions, thereby improving the day to day estimates of methane and ammonia emitted from Southeast swine facilities. Furthermore, scientists found that most of the nitrogen lost from the swine facilities was released as innocuous dinitrogen gas rather than ammonia.

IMPACT/OUTCOME: These studies improve the estimates of greenhouse gas emissions attributed to agriculture, and assist producers, regulatory agencies, and designers in minimizing the impact of high density animal production on the environment.

ACCOMPLISHMENTS: ARS has gathered a significant amount of data on the sources and rates of greenhouse gas emissions. For example, this past year ARS scientists determined that carbon dioxide emissions (a greenhouse gas) from plowed fields were more than double those from no-till fields. ARS scientists (discussed in the first indicator under this goal) gathered vital data on greenhouse gas flux from grasslands, and drew some conclusions about the sources of flux. Sources and rates of greenhouse gasses from livestock production systems were documented in the previous indicator.

IMPACT/OUTCOME: Greenhouse gasses are thought to contribute to the phenomena known as climate change. More and accurate data documenting agriculture’s positive and negative contributions to greenhouse gasses will help predict future levels of greenhouse gasses and develop appropriate strategies to address their effects. This data will also help to address problems of current emissions by identifying sources of greenhouse gasses and devising strategies to lessen them.

PERFORMANCE GOAL 4.1.2.2: Documentation of how changes in the global environment affect agriculture.

Indicators:

During FY 1999, ARS will, with its cooperators, document the effects of rising atmospheric carbon dioxide levels and possible climate change on future competitiveness of weeds with crops and forages. The knowledge gained in a series of field experiments will be used to determine whether crop losses due to weeds increase with global warming, and evaluate the long-term effectiveness of current and projected weed control technologies.

ACCOMPLISHMENTS: ARS scientists in Temple, Texas, found that elevated carbon dioxide levels (such as those expected in the future) reduced water loss by native grasses and increased soil moisture. Changes in soil moisture were associated with an 80 percent increase in mesquite seedling establishment and a 40 percent increase in seedling growth. These results suggest that changes in atmospheric composition may have deleterious effects on rangeland species composition.

IMPACT/OUTCOME: The invasive growth of undesirable species such as mesquite on U.S. grazing lands is a serious problem. Atmospheric carbon dioxide has risen 30 percent in the last century and is expected to double within the next 100 years. This change may affect competition between desirable and undesirable species. Research such as this increases the understanding of problems that may arise from climate change thus enabling producers to be better prepared to face them with minimal economic impact.

ACCOMPLISHMENTS: ARS scientists in Beltsville, Maryland, have shown that the sensitivity of lambs quarters to glyphosate, the active ingredient in a widely used herbicide, is reduced at carbon dioxide levels expected in the next century. Application at the recommended levels killed 100 percent of the plants at ambient carbon dioxide levels, but higher levels of the herbicide were required for 100 percent kill when the carbon dioxide level doubled. In contrast, the sensitivity of pigweed which uses a different pathway for carbon assimilation was not affected.

IMPACT/OUTCOME: Photosynthesis and growth are stimulated in weeds such as lambs quarters that use the so-called C3 pathway for carbon assimilation when carbon dioxide levels are raised. These results indicate that weed management strategies may require modification in the future as atmospheric composition changes. Understanding problems that may arise in the future will allow for the development of strategies to address increased weed growth with limited economic or environmental impact.

STRATEGY 4.1.3: Cropland and grazing land sustainability: Develop cropland and grazing land management strategies that will improve quality, quantity, and sustainability of food and fiber products needed for U.S. competitiveness.

PERFORMANCE GOAL 4.1.3.1: Demonstrate cropland and grazing land management strategies that improve productivity and efficiency of croplands and grazing lands.

Indicators:

During FY 1999, ARS will

identify the genes which control clonal seed production of eastern gamagrass, a native forage species. These genes will enable the breeding of hybrid forages and other crops with genetic characteristics that are genetically stable over generations, thereby decreasing hybrid production costs.

ACCOMPLISHMENTS: Considerable progress was made identifying genes in plants controlling apomixis, a novel and rather infrequent form of reproduction that "freezes" hybrid vigor. Scientists hope to use the gene controlling apomixis to encourage this type of reproduction in corn. This, in turn, will help maintain the positive aspects of hybridization over much longer periods of time than presently possible.

IMPACT/OUTCOME: A more stable hybridization process saves producers money that would be spent revitalizing their crops. It also means that crops will remain as productive as possible over a longer period of time.

provide information to public agencies, private organizations, and directly to farmers and ranchers that will lead to adoption of improved cropland and grazing land management strategies.

ACCOMPLISHMENTS: Scientists have worked diligently to provide timely, pertinent information on grazing land and cropland management strategies. They do this in a variety of arenas. In one example ARS scientists from Beckley, West Virginia work directly with producers and advisory personnel (NRCS, Extension Service), and even teach components at the West Virginia University Extension Service Forage Livestock School. Another example comes from Corvallis, Oregon, where ARS' best management practice options are being incorporated into guides used by NRCS and Oregon State University Extension Service. Numerous locations meet with producers and local government agencies on a regular basis not only to provide information, but to gain input on their research.

IMPACT/OUTCOME: The information provided by ARS' locations on cropland and grazing land management strategies are vital to producers and others in the agriculture system. The information provides opportunities for producers to be more profitable and less harmful to the environment.

complete the development of new decision support software for grazing land managers in Federal agencies and on private ranches. Based upon state of the art simulation models of hydrology, vegetation dynamics, and livestock performance, this planning tool will guide the selection of management options from among those available by generating outcomes related to grazing lands productivity and resource conservation.

ACCOMPLISHMENTS: Scientists in Boise, Idaho, have made the field-scale prototype version of the SPUR 2000. This version has been demonstrated to NRCS and is available to other scientists interested in rangeland ecosystem processes. The model should be available to end users in 2001.

IMPACT/OUTCOME: This model combines the best of SPUR, a model that simulates soil-plant-animal-climate interactions and process, and WEPP, a model that predicts erosion. The resulting tool helps managers select appropriate and alternative management techniques to protect rangeland environment and optimize production of goods and services on that land.

OBJECTIVE 4.2: Risk management: "Improve risk management in the United States agriculture industry."

STRATEGY 4.2.1: Economic and environmental risks: Reduce economic and environmental risks through improved management of agricultural production systems.

PERFORMANCE GOAL 4.2.1.1: Risk reduction strategies and methods transferred to the Nation's agricultural industry.

Indicators:

During FY 1999, ARS will provide information to agencies, organizations, and farmers on the economic and environmental risks associated with various crop production systems in cooperation with State Agricultural Experiment Stations.

ACCOMPLISHMENTS: The Wisconsin Integrated Cropping Systems Trial project, a cooperative project involving ARS, the University of Wisconsin, and the Michael Fields Institute, showed that six different cropping systems that reduced input of chemicals and pesticides and increased diversity (more crops

and/or addition of livestock into the operation) were economically competitive with high input systems even if yields were slightly less. The reduced input systems are also environmentally better.

IMPACT/OUTCOME: Producers can decrease environmental and economic risks by reducing inputs and increasing diversity systems.

complete an intensive statistical analysis of precipitation and temperature patterns in the U.S. associated with El Nino/Southern Oscillation events. The results will provide statistical information that can be used to better prepare for weather extremes driven by this specific phenomenon, and should benefit a broad spectrum of farmers and ranchers. The results will be disseminated through the Internet, in-house reports, and technical publications.

ACCOMPLISHMENTS: Climatic research has adapted a daily precipitation model to include the influence of El Nino when modeling precipitation. This significantly improves model output and can be also used to identify seasonal and regional differences in impacts of El Nino in the U.S.

IMPACT/OUTCOME: Although much of the initial research is complete, the findings have not yet been adapted for use in application models or disseminated through the Internet and technical publications.

conduct research in collaboration with the NOAA Climate Prediction Center to apply El Nino-based predictions of seasonal rainfall to reduce weather-related impacts on farmers and ranchers.

Not enough progress has been made in the research effort directed towards this Performance Indicator. Three ARS locations have been directly involved with El-Nino forecasts but, to date, only one of them, El Reno, has had any direct contact with the NOAA Climate Prediction Center. The El Reno location is planning to develop close cooperation in the future, using the new staff climatologist formerly with the National Weather Service who was hired in August 1999.

STRATEGY 4.2.2: Weather and environmental risks: Develop concepts and technologies for predicting and reducing the socio-economic costs and resource damages associated with extreme weather variability.

PERFORMANCE GOAL 4.2.2.1: Improve strategies and technologies that reduce the effects of extreme weather variability.

Indicators:

During FY 1999, ARS will

provide preliminary results on the effects of overtopping on vegetated earth embankments. These results will strengthen the procedures used for evaluating the risk of embankment failure due to overtopping during extreme floods. This will ensure correct use of ARS developments in risk management technology, and promote greater use of more economical and environmentally friendly structures for flood control.

ACCOMPLISHMENTS: Research is presently underway to evaluate the performance of vegetated earth embankments subjected to overtopping. The three phase earth spillway erosion technology developed for the NRCS SITES software serves as the beginning for this effort. Initial results of full scale overtopping tests suggest that it may be possible to extend this technology to the steeper slopes of earth embankments. The goal of the research is to predict the extent of overtopping required to breach a specific embankment, and the rate of breach, and develop a breach hydrograph once breach has been initiated.

IMPACT/OUTCOME: An International Dam Breach Processes Workshop, jointly sponsored by the ARS and the Bureau of Reclamation was held in March 1998. This workshop brought together engineers and scientists to discuss technology related to dam breach, including that related to overtopping of vegetated earth embankments. The purpose of the research and the exchange is to limit the damage or the incidence of embankment breaches.

develop and release improved forecasting techniques for various diseases, and develop computer-based decision support systems for implementing effective control methods.

ACCOMPLISHMENTS: Developed an improved computer model to predict the likelihood of epidemics of rust and smut diseases of wheat, barley and other grains. The model, named "Morecrop," uses environmental data to predict when conditions are conducive to disease development and when growers should apply fungicide.

IMPACT/OUTCOME: Rust and smut diseases of wheat and other small grains cause significant losses each year. Growers frequently need to apply fungicides to prevent disease epidemics, but the timing of applications is critical. Guided by "Morecrop," farmers can effectively spray when needed and avoid unnecessary applications.

OBJECTIVE 4.3: Safe production and processing: "Improve the safe production and processing of, and adding of value to, United States food and fiber resources using methods that maintain the balance between yield and environmental soundness."

STRATEGY 4.3.1: Environmentally safe pest management: Develop environmentally safe methods to prevent or control pests (insects, weeds, pathogens, etc.) in plants, animals, and ecosystems.

PERFORMANCE GOAL 4.3.1.1: Deliver integrated pest management strategies that are cost effective and protect natural resources, human health, and the environment.

Indicators:

During FY 1999, ARS will

complete extensive multi-year studies to determine the mode of transmission of cryptosporidium parvum in the environment, the role of oysters and other shellfish in the transmission of the parasite to humans, and the efficacy of emerging technologies and equipment for prevention of watershed contamination. The knowledge from these studies will be provided to the EPA, American Water Works, and State and Federal health agencies in the form of recommendations to prevent transmission of waterborne cryptosporidium parvum, and control of disease transmission by shellfish.

ACCOMPLISHMENTS: ARS scientists found that oocysts from *Cryptosporidium parvum*, a protozoan parasite causing diarrheal illness and death in livestock and humans, could survive and remain infectious in seawater for twelve weeks suggesting the possible concentration of filter feeders such as oysters. A subsequent study found *Cryptosporidium parvum* oocysts in oysters from 11 tributaries of the Chesapeake Bay. Oocysts were found to adhere to or become entrapped by soil after which they rapidly decompose.

IMPACT/OUTCOME: These results highlight the need for improved manure management to prevent oocyst contamination of water. Management practices that incorporate oocyst contaminated manure into the soil should prevent leaching of oocysts to groundwater or runoff to surface waters.

complete a three year evaluation of natural enemies (phorid flies, parasitic ants, and microsporidia) for management of fire ant populations. The knowledge from these studies will be provided to State regulatory agencies, Extension Service officials and pest control operators.

ACCOMPLISHMENTS: ARS scientists in Gainesville, Florida have established a cooperative agreement with the Southern Legislative Council (SLC), Council of State Governments (CSG) for release of biocontrol agents in the fire ant infested states of the SLC. Phorid flies were released in the eight states: Texas, Oklahoma, Arkansas, Louisiana, South Carolina, Florida, Alabama and Tennessee. The flies have expanded to cover more than 120 acres at one site. In addition, flies were seen attacking fire ant colonies almost three miles from the nearest known fire ant infested population. Similarly, *Thelohania solenopsae* were released and have been monitored for over two and one-half years. Infections of the fire ant pathogens were detected in six of the ten states where field inoculations were made in 1999 to evaluate the efficacy of the pathogen under different geographic and climate conditions. Fire ant populations were reduced by as much as 61 percent in a field site where natural infections of the fire ant pathogens occurred.

In addition, ARS scientists have helped APHIS - Plant Pest Quarantine (PPQ) in streamlining their treatment protocols to eliminate the risk of expansion of fire ants through transport of nursery crops.

IMPACT/OUTCOME: This technology when integrated with baits will significantly reduce the use of pesticides for control of fire ants in urban, suburban and agricultural environments.

in cooperation with university and industry scientists, conduct validations of integrated disease control strategies that can be used as alternatives to preplant soil fumigation with methyl bromide for strawberries and tomatoes.

ACCOMPLISHMENTS: The impending loss of methyl bromide for pre-plant soil fumigation is a serious threat to growers of many crops because of anticipated increased loss to disease. Integrated strategies involving application of alternative chemicals, use of disease-resistant varieties, and improved cultural practices were tested on a commercial scale in grower production fields in California (strawberries and perennials) and Florida (tomatoes). These were scale-ups of the treatments found most promising in small-scale plots. Some treatments were nearly as effective as methyl bromide fumigation in these trials, but they are likely to be more expensive and their effectiveness may vary from year to year and location to location.

IMPACT/OUTCOME: Practical and feasible alternatives to methyl bromide are critical to maintaining profitability for many crops and allowing growers to remain in business.

*continue implementation of the areawide pest management program for leafy spurge. Evaluation of the integration of biological, chemical and cultural techniques will continue with local, State and Federal customers that are part of TEAM Leafy Spurge. New biological control agents for specific niches not utilized by the *Aphthona* spp. will be sought in Europe using staff and facilities at the ARS European Biological Control Laboratory in Montpellier, France. Promising agents will be introduced after Federal and State approval. Technology transfer will be provided through field days, bulletins, databases, and other means.*

ACCOMPLISHMENTS: Leafy spurge, a Eurasian native, is one of the most pernicious rangeland weeds to invade the United States. It displaces native vegetation, reduces cattle grazing and wildlife habitats, decreases rangeland plant diversity, and lowers land values. Currently, more than five million acres in 29 States are infested. ARS scientists at Sidney, Montana, have led an areawide management partnership program since 1997 in Montana, North Dakota, South Dakota, and Wyoming using a weed predator, the *Aphthona* flea beetle, and other biological and cultural practices. Where *Aphthona* species have become established, the insects eliminated leafy spurge and the areas continue to remain free of the weed. The flea beetles may require time but they appear to be a permanent long-term, and low cost solution.

IMPACT/OUTCOME: In 1999, at a "Spurgefest" field day in Medora, North Dakota, 20 million *Aphthona* flea beetles were given to 206 ranchers and land managers from 50 different counties in seven States for use in eliminating this serious weed pest.

complete the technology transfer process of mating disruption for control of the codling moth on apples and pears in Washington, Oregon, and California, with complete transfer and adoption of the technology by growers.

ACCOMPLISHMENTS: The technology of mating disruption as an areawide pest management solution to codling moth in the Western States on apples and pears has now been transferred to growers across the region. In Washington State alone, the number of acres both within and outside the program increased from 24,000 in 1997 to more than 60,000 in 1999.

IMPACT/OUTCOME: Apple and pear growers now have a viable areawide program for controlling codling moths and other secondary pests in the Western States. Because of widespread acceptance of the areawide concept, ARS plans to continue working cooperatively to enhance its partnership with the States and private sector.

release and evaluate new biological control agents from China and Israel for control of saltcedar, an introduced exotic plant that is causing severe environmental damage in riparian areas throughout the Western United States. USDA-APHIS has selected this project as its number one biological control project for future implementation in the Western region of the U.S.

ACCOMPLISHMENTS: Saltcedar is an invasive exotic weed intentionally introduced from Eurasia for erosion control and as an ornamental plant which has escaped cultivation. It now invades virtually all riparian corridors in the West. A multiagency "Saltcedar Consortium" was developed and led by ARS to aid in program planning. The first biological control agent for saltcedar, a *Diorhabda* leaf feeding beetle, was released from field cages at eight sites in six Western States, and plans are in place for long-term evaluation and monitoring.

IMPACT/OUTCOME: After extended negotiations, approval for release of the leaf feeding beetle has been obtained from the Animal and Plant Health Inspection Service and the Fish and Wildlife Service. This is a breakthrough case involving approval for release of a biological control agent under both the National Environmental Policy Act and the Endangered Species Act. The Saltcedar Consortium is a model of how a team-based program can plan, implement and monitor a major weed management program.

develop methods to transfer insect genetic characteristics which will allow for the transformation of insect tissues in cell culture systems. This is one of the first steps in genetically modifying insects that may lead to new ways of controlling critical pests.

ACCOMPLISHMENTS: As a long-term alternative approach to insect management, the Insect Biocontrol Laboratory in Beltsville, Maryland, has undertaken development of a virus-based vector system for delivery of genes to insect cells and whole insects. This vector is being developed from an unusual braconid (*Glyptapanteles indiensis*) polydnavirus (GiPDV), primarily as an insect transformation system, and secondarily, as a potential vehicle for generating transgenic insects. GiPDV was discovered by ARS scientists to be the first insect virus capable of integration into the host genome. The scientists have also determined the GiPDV host range, demonstrated integration of GiPDV into the host (gypsy moth) genome, and found its capability to transform six cell lines, including those from moths and beetles. Regulatory genes have also been discovered.

IMPACT/OUTCOME: This research and development project represents a long-term strategy for insect biocontrol.

provide additional research support for the new USDA Office of Pest Management.

ACCOMPLISHMENTS: In FY 1999, ARS provided funding in the amount of \$1,089,325 to the USDA Office of Pest Management. These funds covered salaries (including benefits) and operating costs for 11 FTE.

IMPACT/OUTCOME: ARS support ensured the operation of the Office of Pest Management in FY 1999.

complete the testing of improved techniques to control protozoan and helminthic parasites of poultry and livestock by nondrug methods. ARS in partnership with the poultry industry will test several techniques, including formulation of viable oocyst vaccine, combinations of drugs and vaccines, irradiated attenuated vaccine, and the natural product, betaine, to protect breeder and broiler chickens against coccidiosis caused by field strains of coccidia. ARS will develop and evaluate new and improved immunostimulants for livestock against parasitic diseases, such as cryptosporidiosis in cattle, toxoplasmosis in pigs, and helminths in cattle and pigs.

ACCOMPLISHMENTS: Vaccination coupled with anticoccidial drugs are more effective than anticoccidial drugs alone. Trials conducted by scientists in Beltsville, Maryland, showed that broiler chicken flocks treated with anticoccidial drugs and vaccination outperformed flocks on anticoccidial drugs alone. This regimen was more effective in protection of chickens against coccidiosis, an economically important intestinal disease caused by an intracellular protozoan parasite.

Nasal application of fowlpox recombinant coccidiosis vaccine: Scientists at Beltsville, Maryland, demonstrated that nasal application of a fowlpox recombinant vaccine containing genes from the parasite, *Coccidia*, provided protective immunity in poultry against this economically important disease.

A new diagnostic test for toxoplasmosis in pigs: Scientists at Beltsville, Maryland, developed a rapid and sensitive ELISA test for detection of toxoplasmosis, a parasitic infection that causes serious disease in humans. One of the methods the parasite can be transmitted to humans is through consumption of undercooked infected meat. Toxoplasmosis is emerging as a nontariff trade barrier to U.S. exports of pork products. This new assay is as sensitive as the currently used agglutination test and will provide a more accurate and specific means for producers to monitor their herds for infection.

IMPACT/OUTCOME: The new approaches are leading to the reduced use of drugs and increasing use of integrated strategies. The new recombinant technologies will lead to more effective and economic methods of disease control.

*develop and use innovative and efficient approaches to determine the mode of transmission of *Cryptosporidium parvum* in the environment, especially the possible role of animal waste and shellfish in the transmission of the parasite in cattle and humans.*

ACCOMPLISHMENTS: ARS scientists at Beltsville, Maryland, identified antigens (proteins) of *Cryptosporidium parvum* useful for diagnostic purposes and cloned DNA sequences encoding these antigens. Patents were obtained and additional patents are pending. ARS scientists developed a nested polymerase chain reaction (PCR) assay for improved detection of *Cryptosporidium parvum*. It is now possible to detect *Cryptosporidium* in shellfish, surface water, and animal tissues, where they would be undetected or underdetected by conventional assays. Scientists have demonstrated that shellfish will take up oocysts from water and thereby can serve as excellent indicators of water pollution. Studies, extended from the laboratory to the field, demonstrated contamination of oysters from the Chesapeake Bay with *Cryptosporidium* oocysts in areas adjacent to cattle farms and in areas near waste water outfalls. Other shellfish (clams and mussels) were also found with infectious *Cryptosporidium* oocysts. Migratory waterfowl were shown to be mechanical vectors of infectious *Cryptosporidium parvum* oocysts.

IMPACT/OUTCOME: This research has led to further investigation by the Centers for Disease Prevention and Control (CDC) to determine the risk of *cryptosporidiosis* in humans from eating undercooked raw shellfish or through contaminated water.

initiate transfer of information to regulatory agencies, such as APHIS-PPQ, and State agencies, such as Southern Legislative Conference and Council of State Governments on how to use biologically-based technologies, including natural enemies (phorid flies, microsporidia and parasitic ants) for management of fire ant populations. This technology transfer will help to reduce the use of chemical pesticides.

ACCOMPLISHMENTS: ARS scientists in Gainesville, Florida, have established a cooperative agreement with the Southern Legislative Council (SLC), Council of State Governments (CSG) for release of biocontrol agents in the fire ant infested states of the SLC. Phorid flies were released in the eight states: Texas, Oklahoma, Arkansas, Louisiana, South Carolina, Florida, Alabama and Tennessee. The flies have expanded to cover more than 120 acres at one site. In addition, flies were seen attacking fire ant colonies almost three miles from the nearest known fire ant infested population. Similarly, *Thelohania solenopsae* were released and have been monitored for over two and one-half years. Infections of the fire ant pathogens were detected in six of the ten states where field inoculations were made in 1999 to evaluate the efficacy of the pathogen under different geographic and climatic conditions. Fire ant populations were reduced by as much as 61 percent in a field site where natural infections of the fire ant pathogens occurred.

In addition, ARS scientists have helped APHIS - Plant Pest Quarantine (PPQ) in streamlining its treatment protocols to eliminate the risk of expansion of fire ants through transport of nursery crops.

IMPACT/OUTCOME: This technology when integrated with baits will significantly reduce the use of pesticides for control of fire ants in urban, suburban, and agricultural environments.

develop and field test biologically-based pest management methods effective for controlling biting and bloodsucking flies, mosquitoes, and filth flies. ARS will conduct research on the development and bioassay of attractants and repellents for control of and protection from arthropod vectors of diseases.

ACCOMPLISHMENTS: ARS scientists at Beltsville, Maryland, developed a novel test method and module for the bioassay of new candidate repellents using human subjects. The new bioassay technology is significantly more efficient than anything previously used in repellent research. ARS scientists from Gainesville, Florida, have discovered compounds from human skin that attract and other compounds that repel hungry mosquitos. This knowledge is being used to develop attractant-antagonist-based personal protection systems for human and zoophylaxis technology for livestock.

IMPACT/OUTCOME: This research will help the Department of Defense use alternate repellents to the current skin repellent, Deet, to protect U.S. troops overseas from blood sucking and disease transmitting insects.

complete transfer to the U.S. bee industry and State regulatory agencies of its patented technology for gel formulation of formic acid to replace the chemical method "fluvalinate in Apistan strip" for controlling parasitic bee mites. Apistan used during the honey flow period contaminates honey, whereas formic acid is a natural component of honey and will not be a concern for food safety of honey. In addition, ARS will transfer a new fast and easy-to-use assay method to determine whether parasitic bee mites are resistant to fluvalinate.

ACCOMPLISHMENTS: At the Bee Research Program Review at Beltsville, Maryland, ARS field tested a formic acid gel formulation for the control of Apistan resistant mites. A patent was granted to ARS in November 1997. In 1998, ARS licensed the patent to the industry, "BetterBee" which obtained an EPA label in the biopesticide section. The "BetterBee" has the production for mite control. In addition, ARS scientists at Beltsville, Maryland, and Weslaco, Texas, have developed a sensitive protocol to determine fluvalinate resistant bees. This method is being used by the beekeepers.

IMPACT/OUTCOME: This is an environmentally safe method of bee mite control. It is significantly contributing to the reduction of chemical method resistant parasites of bees.

STRATEGY 4.3.2: Integrated agricultural production systems: Develop knowledge and integrated technologies for promoting use of environmentally sustainable agricultural production systems.

PERFORMANCE GOAL 4.3.2.1: Demonstrate the effectiveness of integrated agricultural production systems in the improvement of natural resources and protection of the environment.

Indicators:

During FY 1999, ARS will demonstrate production systems that restore or enhance soil, water, and air quality while maintaining productivity.

ACCOMPLISHMENTS: The amount of nitrogen leaching from agricultural fields was reduced by using a combination of tests, such as crop chlorophyll levels, early and late spring nitrate measurements, crop rotations, tillage, and water management while maintaining productivity. The research was conducted at various ARS locations throughout the U.S. with each having a site specific cropping system so that, while the particular production system was unique for a region, the goal of reducing nitrogen loss to the environment was achieved.

IMPACT/OUTCOME: The impact is cleaner water because of less nonpoint source nitrogen pollution from agriculture.

ACCOMPLISHMENTS: ARS scientists developed a high residue conservation tillage system for production of ultra narrow row cotton on marginal or degraded soils of the Southeastern United States. Using a narrow row system, cotton yields increased up to 60 percent when compared to conventionally tilled standard row width cotton.

IMPACT/OUTCOME: Producers in the Southeastern U.S. are rapidly adopting this new technology. Acreage in ultra narrow row cotton production has increased from 3,500 acres in 1997 to approximately 200,000 acres in 1999.

continue long-term sustainable agriculture projects involving rotation of corn, wheat, soybean and cover crop, including some projects on sloping, erodible land and where organic farming practices are employed.

ACCOMPLISHMENTS: Scientists completed an analysis of 15 years of soil, plant, and water data collected from 36 plots in Northeastern Iowa. The purpose was to devise solutions to minimize the impact of agriculture on the environment through new and improved management practices. One finding showed that tillage practices that preserve or increase soil carbon (organic matter) can prevent the loss of nitrogen to surface or groundwater while improving the quality of the soil. A decision support system using this information will be available for use by producers in late 2000.

IMPACT/OUTCOME: Nitrogen leaching from agricultural fields is a serious water quality problem. Management techniques recommended from research of this type not only minimizes agriculture's effect on the environment, but also keep farm land more productive by holding nutrients in the soil instead of permitting them to run off in the water.

PERFORMANCE GOAL 4.3.2.2: Provide computer-based models and decision-support systems to farmers, public agencies, and private organizations.

Indicators:**During FY 1999, ARS will**

deliver for on-farm beta testing a second generation simulation-based cotton production decision aid. This new tool used, in concert with precision farming techniques, will enable cotton producers to make more environmentally friendly decisions about the amounts and timing of nitrogen and water applications. This should result in more efficient use of nitrogen with less environmental pollution by nitrates, increase yields, and enhance profitability.

ACCOMPLISHMENTS: ARS scientists worked with a validation team to test the new cotton model against field data. The validation team is an intermediate step between the completed software and actual beta testing. The model will be turned over to on-farm testers next season.

IMPACT/OUTCOME: The new cotton model is more robust and simulates cotton growth and production much better than it did at the start of the year. The model will assist cotton farmers in managing their cotton crops to optimize inputs, increase profitability, and reduce environmental impacts of their production, thus increasing profits and safeguarding water quality.

deliver a wind erosion simulation model called Revised Wind Erosion Equation. This model predicts average annual soil loss induced by wind, with consideration given to soil surface conditions and properties, and average weather conditions. The model and user manual will be available on the Internet, to provide information that producers can use to better manage their farms to reduce erosion by wind, and thereby protect the environment while sustaining long-term productivity.

ACCOMPLISHMENTS: The Revised Wind Erosion Equation is now called the Wind Erosion Prediction System. The first edition of the system was delivered to NRCS this year.

IMPACT/OUTCOME: The system provides a more reliable science-based technology for improving erosion prediction; developing soil, climate, and crop specific control strategies; and assessing erosion damage and environmental impact. This is important, because wind erosion causes about 44 percent of the 2.13 billion tons of soil lost per year from U.S. cropland. Soil loss and its degradation are associated with water and air pollution.

STRATEGY 4.3.3: Waste management and utilization: Develop and transfer cost effective technologies and systems that use agricultural, urban, and industrial wastes for production of food, fiber, and other products.

PERFORMANCE GOAL 4.3.3.1: Demonstrate technologies to store, mix, compost, inoculate, incubate, and apply wastes to obtain consistent economic benefits while at the same time minimizing environmental degradation, nutrient loss, and noxious odors.

Indicators:

During FY 1999, ARS will develop methods for co-composting animal manure and yard products (grass, leaves), construction materials (plywood, sawdust, dry wall), and industrial (coal byproducts including fly ash) byproducts. Materials will be converted from wastes into beneficial products for use on urban, suburban and rural lands.

ACCOMPLISHMENTS: A decision support system has been developed that makes possible the co-composting of manure, municipal, construction, and industrial byproducts to produce a consistent compost for use in agricultural and horticultural applications.

IMPACT/OUTCOME: Composting is an excellent method of recycling nutrients to provide organic matter for the soil. Increasing the types of material that can be composted and recycled benefits not only agriculture but also municipalities and industries.

ACCOMPLISHMENTS: Methods were developed to co-compost manure with urban byproducts such as yard waste, while minimizing losses of nitrogen during the composting process.

IMPACT/OUTCOME: These methods should bring about development of urban and rural partnerships to convert municipal and animal wastes into valuable products for agricultural and horticultural uses. If yard wastes can be used in this manner, valuable landfill space will be saved.

PERFORMANCE GOAL 4.3.3.2: Demonstrate the conversion of agricultural waste into liquid fuels and industrial feedstocks.

Indicators:

During FY 1999, ARS will

develop technology that will make possible conversion of poultry feather waste into fiber that can be used as a feedstock for the production of paper, containers, filters and absorbent products. Conversion of the waste to fiber can create value added products from the one million tons of feather waste generated annually by the U.S. poultry industry.

ACCOMPLISHMENTS: A process has been developed by ARS scientists to convert poultry feather waste into fiber pulp with macroscopic consistency, texture, and hardness comparable to wood fiber. Products currently made from wood fiber could potentially be made from feather fiber. Feather fiber, as a raw material for commercial products, has a value 3 to 5 times greater than feather meal, which is currently produced from rendering feathers.

IMPACT/OUTCOME: Approximately one million tons of feather waste is generated annually by the U.S. poultry industry. The conversion of feather waste to fiber has the potential to create value added products and solve a major solid waste management problem for the poultry industry.

release a model to feeder/farmer operations for general application to make more efficient use of cattle waste.

ACCOMPLISHMENTS: ARS scientists at the Biological Engineering Research Unit in Clay Center, Nebraska, have made a nutrient fate model available nationally. Tests were conducted on cooperators' farms and updates for improvements will continue.

IMPACT/OUTCOME: Use of the model will improve the efficiency of manure nutrient recycling and prevent phosphorus build up near the soil surface.

communicate to the Committee on Animal Nutrition (CAN) of the National Research Council feeding recommendations for lowering phosphorus in lactating cow diets.

ACCOMPLISHMENTS: ARS scientists at the U.S. Dairy Forage Research Center, Madison, Wisconsin, conducted research on phosphorus in diets of lactating cows which confirms that farmers generally feed an amount in excess of the National Research Council (NRC) recommendations. The NRC recommendations are more than adequate, so farmers are wasting money and increasing the risk of phosphorus contamination of the environment. This information was made available to the NRC for updating the next revision of the "Nutrient Requirements of Dairy Cattle."

IMPACT/OUTCOME: NRC validated information on phosphorus feeding will be incorporated into the next edition of the publication, "Nutrient Requirements of Dairy Cattle." Application of the revised feeding levels will save farmers money and reduce the risk of phosphorus contamination of the environment.

GOAL 5: Empower People and Communities, Through Research-Based Information and Education, to Address the Economic and Social Challenges of Our Youth, Families, and Communities.

Analysis of Results: This goal focuses primarily on activities designed to get research-based information to individuals and communities that will be useful to them in addressing a wide range of socio-economic issues. Under Goal V, seven Indicators are aligned under six Performance Goals. Because of the unique and dynamic nature of research, several Indicators were added to the Report that did not first appear in the Annual Performance Plan for FY 1999. This was done to ensure that significant accomplishments that were not anticipated last year were reported. While it is not possible to report research accomplishments numerically, the progress projected in all seven Indicators was completed or substantially completed during FY 1999.

OBJECTIVE 5.1: Economic opportunity and technology transfer: "Conduct agricultural research to promote economic opportunity in rural communities and meet the increasing demand for information and technology transfer throughout the United States agriculture industry."

STRATEGY 5.1.1: Rural development opportunities: Develop farming systems tailored to diverse agricultural production enterprises to enhance profits, sustainability, and environmental quality.

PERFORMANCE GOAL 5.1.1.1: Experimentally demonstrate the successful operation of small scale production and processing systems, evaluate small scale animal production systems, and enhance high value agricultural products.

STRATEGY 5.1.2: Information access and delivery: Provide improved access to and dissemination of information to increase public knowledge and awareness of agricultural research, to aid technology transfer, and to speed up sharing of new knowledge.

PERFORMANCE GOAL 5.1.2.1: Make information on ARS research results and inventions available electronically via the Internet and similar resources.

Indicators:

During FY 1999, ARS will display publications, home pages, and other means to expand the public's knowledge of how to access ARS technology.

ACCOMPLISHMENTS: Information on more than 70 licensable patent applications and issued patents were added to the Office of Technology Transfer (OTT) home page. Links to economic development departments in Kansas, Delaware, and Florida were also added. Reciprocal links were added to the home pages of each participating State, as well as selected businesses and trade/technology transfer organizations. A new selection added to the OTT home page provides industry with a comprehensive review of past ARS research projects that have been transferred to the private sector to exemplify the technology transfer program. ARS technologies available for licensing or research partnership were also featured in press releases and articles in the ARS magazine.

IMPACT/OUTCOME: More than 150 online requests for further information were received, researched, and answered via the OTT home page which expedited delivery and services of ARS technology.

Reciprocal links from the Enterprise Florida home page led to direct on-line requests from Florida businesses, thus creating a new avenue of commercialization opportunity for ARS technology.

make information from the leafy spurge areawide pest management program available through a CD ROM and an Internet home page. This will include information on the targeted weeds, biological control agents, demonstration sites, etc.

ACCOMPLISHMENTS: A CD ROM was prepared and released and an Internet site was established to communicate information on controlling leafy spurge to a wide range of customers and stakeholders. The CD ROM is available from the ARS Northern Plains Agricultural Research Laboratory in Sidney, Montana. The information on the home page can be accessed at www.team.ars.usda.gov.

IMPACT/OUTCOME: The information made available on this CD ROM and Internet home page will enable State and Federal agencies, farmers, ranchers and other customers and stakeholders to use the most current science-based information in their efforts to control this invasive weed.

PERFORMANCE GOAL 5.1.2.2: Provide more cost-effective and efficient public information and technology transfer.

Indicators:

During FY 1999, ARS will further expand efforts to be actively involved in the planning and organization of several events highlighting new ARS technologies and identifying industry partners for commercialization.

ACCOMPLISHMENTS: ARS staff members participated in 17 trade shows/technology transfer conferences. They attended trade shows related to biotechnology, fruit, vegetable, engineering, and information systems industries where ARS scientists exhibited their technologies and commercialization possibilities. Also, OTT filed 72 new patent applications; participated in 103 new CRADAs; licensed 23 new products; and developed 70 new plant varieties to be released to industry for further development and marketing.

IMPACT/OUTCOME: More than 800 packages of information on licensable technologies and the technology transfer program were distributed to small and large corporations at the trade shows. Direct interactions led to follow up actions with more than 200 companies to improve their customer service and maximize commercialization opportunities.

PERFORMANCE GOAL 5.1.2.3: Research programs include information and technology transfer considerations.

Indicators:

During FY 1999, ARS will

enhance its partnership with local and State customers who are helping with the site selection, distribution of biological control agents, testing of other management techniques, technology transfer to land managers, and evaluation of the leafy spurge areawide pest management program.

ACCOMPLISHMENTS: Local and State grower adoption of the adult corn rootworm attracticide areawide technology has brought about for program expansion in Texas and Kansas. Full transfer of the technology is expected to occur in the next two years.

IMPACT/OUTCOME: The corn rootworm areawide pest management program was awarded an ARS Technology Transfer Award because of customer acceptance and expanded adoption of the technology in the more than 30,000 acres of corn in the demonstration projects across Illinois/Indiana, Iowa, Kansas, South Dakota, and Texas.

enhance its partnership with local and State customers who are participating in the areawide IPM program for control and management of corn rootworm in the Midwestern U.S.

ACCOMPLISHMENTS: The corn rootworm areawide management program has become an excellent example of cooperative research and development activities among ARS, university, and private industry personnel. Since its inception in 1996, the program partnership has grown from five demonstration sites and 143 growers with 24,580 acres to nine demonstration sites and 167 growers with 34,580 acres. Six states, Kansas, Iowa, Nebraska, Texas, Illinois, and Indiana, are currently participating in the program.

IMPACT/OUTCOME: A highly successful program review and partnership meeting was held in Kansas City, Missouri, on October 13-15, 1999. Overall participating partner field sites in the various states have a two- to three-fold reduction in adult rootworm population, although adult rootworm populations were higher than expected, but in all instances less than 10 percent of all fields in each state had economic damage from larval feeding in 1999. Partners in the program were awarded an ARS Technology Transfer Award in February 2000 "for recognition of outstanding cooperative technology transfer efforts involved in implementation of the national areawide IPM program for corn rootworm.

continue to include members of OTT on teams to promote technology transfer in national priority areas. Presentations will be made at meetings of Area Research Leaders to sensitize them to the need to include technology transfer considerations early in the research planning process.

ACCOMPLISHMENTS: Over 40 meetings were held with staff members of OTT and the National Program Staff (NPS) to establish or modify agency policy for the protection of intellectual property, especially plant germplasm. NPS was invited to attend patent review committee meetings that concerned invention disclosures. In addition, technology transfer coordinators held more than 25 workshops at field locations. The meetings and workshops heightened the awareness of research scientists about patents, CRADAs, and disclosure of intellectual property.

IMPACT/OUTCOME: Increased contact between the NPS and OTT members enhanced the ability of individual ARS laboratories to work cooperatively with the private sector in areas of common interest without compromising private sector partner confidentiality. These efforts resulted in a more focused and consistent approach to intellectual property rights, the development of policies to guide scientists in their research efforts and the furtherance of the Agency mission. Earlier consideration of technology transfer issues in the research planning stage helps protect the government's and taxpayer's interest in intellectual property rights.

STRATEGY 5.1.3: Commercialize research results: Develop technology transfer systems that lead to commercialization of research results by industry.

<p>PERFORMANCE GOAL 5.1.3.1: Provide small businesses with contacts and information on the programs available from public and private sources.</p>

Indicators:

During FY 1999, ARS will expand efforts to identify groups that will enhance the likelihood of identifying partners for commercialization of ARS technologies with particular emphasis on organizations concerned with minority businesses and rural development.

ACCOMPLISHMENTS: OTT continued its efforts to interact with State economic development entities to deliver new technologies. It coordinated technology transfer opportunities with the USDA Rural Business Service, Small Business Innovation Research Program, and the Resource Conservation and Development Program. OTT actively represented ARS research concerns before the Federal laboratory consortium in technology transfer outreach activities.

IMPACT/OUTCOME: Partnership activities with State economic development entities have led to interaction and formal agreements with ARS laboratories nationwide, as well as public financial backing of companies seeking to obtain licenses for ARS patented technology. Interaction with the California venture capital community led to providing financial resources to ARS licensees to further enhance commercialization efforts. Interaction in the Resource Conservation and Development program led to creation of two pilot projects that will incorporate various USDA resources to enhance the transfer ARS technology.

PERFORMANCE GOAL 5.1.3.2: Expand the types of agreements used by ARS and delegate signatory authority to the lowest feasible level.

Indicators:

During FY 1999, ARS will expand negotiation of licenses for ARS technology by continuing to train of Technology Transfer Coordinators in the procedures. This will enhance customer service and facilitate the licensing process. OTT Headquarters staff will provide oversight to ensure consistent implementation of Federal regulations.

ACCOMPLISHMENTS: A standard generic CRADA was developed for use by the technology transfer coordinators. A license workshop involving ARS technology transfer coordinators has increased the number of OTT staff members trained to negotiate licenses. Two additional patent advisors were added to the OTT staff, as well as a Legal Instruments Examiner. In addition, a License Specialist and Licensing Assistant were added to the staff.

IMPACT/OUTCOME: Technology Transfer Coordinator involvement in license negotiations will markedly expedite licenses finalization for improved customer service. The overall outcome and number of licenses finalized will also be enhanced through the addition of the License Specialist and Assistant. Two additional Patent Advisors and Legal Instruments Examiner will address a backlog of patent applications. This will reduce the necessity to contract for outside patent assistance, decrease operating costs, and ensure quality control of ARS inventions.

ADMINISTRATIVE, PROGRAMMATIC, AND MANAGEMENT INITIATIVES

Initiative 1: Support Education: "Support Higher Education in Agriculture to Give the Next Generation of Americans the Knowledge, Technology, and Applications Necessary to Enhance the Competitiveness of United States Agriculture."

All of the activities relating to this initiative are cross-cutting in nature and are reflected in the strategies and performance measures under the five ARS Goals and Initiatives 2 and 3.

Initiative 2: National Agricultural Library: "Ensure and Enhance Worldwide Access to Agricultural Information through the Programs of the National Agricultural Library (NAL)."

Analysis of Results: This Initiative focuses on the work of the National Agricultural Library. Under this Initiative, 13 Indicators are aligned under 9 Performance Goals. The progress projected in all 13 Indicators was completed or substantially completed during FY 1999.

STRATEGY 2.1: Access to information: Collect, organize, and provide access to information that supports agricultural programs and responds to information needs.

PERFORMANCE GOAL 2.1.1: Implemented selection guidelines for the electronic resources to be acquired and used by NAL.

Task completed in FY 1997.

PERFORMANCE GOAL 2.1.2: Expanded representation of electronic formats such as Internet resources, online databases, and digital documents in AGRICOLA and NAL's online catalog.

Indicators:

During FY 1999, NAL will

continue the transition from print to electronic collections.

ACCOMPLISHMENTS: To prepare for the move of Reference to its temporary location during renovation, NAL cancelled subscriptions to the paper copies of several expensive reference tools and abstracting and indexing services that are duplicated by electronic subscriptions, most notably, Chemical Abstracts.

IMPACT/OUTCOME: Users have quick and convenient access to key references. These tools can now be accessed by multiple simultaneous users from multiple locations. NAL saved several thousands of dollars in materials expenditures by cancelling these paper copies.

implement active links between the AGRICOLA citations to USDA electronic resources and full text documents. NAL will acquire and index additional electronic journals.

ACCOMPLISHMENTS: NAL added to the AGRICOLA database, references and Internet addresses for over 1,100 electronic documents, reports and serial titles which were predominantly USDA publications. A mechanism was developed to identify invalid links to the Internet resources and begin maintaining these to ensure ongoing access.

IMPACT/OUTCOME: Users of NAL's Internet AGRICOLA database can access immediately the full text of relevant resources retrieved in searches. Access to currently maintained electronic resources is timely and convenient.

PERFORMANCE GOAL 2.1.3: A gateway is provided to a large body of electronic information on agriculture over a network such as the Internet.

Indicators:

During FY 1999, NAL will

in collaboration with its land grant university partners, evaluate alternatives provided by new technology that will enhance the content, features, services, and use of the system.

ACCOMPLISHMENTS: NAL and its land grant partners initiated a pilot project which seeks to demonstrate that use of standard metadata and classification structure will improve access.

IMPACT/OUTCOME: The pilot project is underway but will not conclude until FY 2000.

develop a classification structure for organizing AgNIC resources by subject. NAL will implement a standard metadata record for description of and access to AgNIC information resources.

ACCOMPLISHMENTS: NAL developed a subject classification structure for organizing AgNIC resources, and a standard metadata record for the description and access to AgNIC information resources. The metadata record maps to several international standards for description, including Dublin Core, GILS (Government Information Locator Service), and MARC (Machine Readable Cataloging).

IMPACT/OUTCOME: If, at the conclusion of the pilot project, these two NAL-developed tools for organizing AgNIC are adopted for widespread use, they have the potential for dramatically improving access to agricultural information.

PERFORMANCE GOAL 2.1.4: Demonstrate increased use of agricultural information by institutions of higher education.

Indicators:

During FY 1999, NAL will collect and analyze tracking information to determine customer needs. This information will be valuable in restructuring and enhancing the information and services offered to institutions of higher education.

ACCOMPLISHMENTS: NAL has collected and is entering into a database, customer requests for FY 1997 and FY 1998. The results of this study will be reported in the second quarter of FY 2000.

IMPACT/OUTCOME: The resulting usage data will help in planning future products and services.

STRATEGY 2.2: Meet customer needs for information: Anticipate and provide information products and services, including educational programs, that enable NAL's diverse customers to identify, locate, and obtain desired information on agricultural topics.

PERFORMANCE GOAL 2.2.1: The time for processing requests for services and delivering the information requested is further reduced.

Indicators:

During FY 1999, NAL will expand electronic methods of document delivery to reduce time to requesters. New software delivery packages and enhancements to current software will continue to be reviewed and implemented.

ACCOMPLISHMENTS: NAL expanded electronic methods of document delivery to reduce time to requesters. New software delivery packages and enhancements to current software were reviewed and implemented. Electronic requests continued to be the primary method of transmission. NAL upgraded all four Ariel™ workstations and added a fifth Ariel™ workstation in FY 1999. All Ariel™ workstations received upgraded software packages. Additional memory was added to two fax/scanners for greater efficiency in sending and receiving files. An additional high volume printer was also added. The Pineville Arkansas Forest Service Station, the Arboretum library, the ARS Plum Island Animal Disease Center library, and the J. D. Boyd Library of Alcorn State University were provided copies of Ariel™ software for their use.

IMPACT/OUTCOME: As a result of these activities, efficiency and accuracy in receipt and delivery of requested materials continues to improve.

PERFORMANCE GOAL 2.2.2: The gap between the time that information is published and made available in NAL produced databases is further reduced.

Indicators:

During FY 1999, NAL will

complete the conversion of bibliographic records to electronic form for all monographs in its collection and release them in AGRICOLA. NAL will also develop plans for adding records of older USDA serials to AGRICOLA.

ACCOMPLISHMENTS: NAL completed the conversion of bibliographic records for monographs. The addition of the records to AGRICOLA has begun and is scheduled to be completed by December 31, 1999.

IMPACT/OUTCOME: More printed resources in agriculture and related topics were made available to users through NAL's online catalog and distributed to AGRICOLA users.

increase the use of shelf-ready processing for additional categories of collection materials.

ACCOMPLISHMENTS: Workflow changes were implemented to add records to the catalog for books at the time of order receipt.

IMPACT/OUTCOME: Books received from the Library's principal vendor are accompanied by cataloging records, expediting the addition of these books to the collection with a minimum of additional processing. Bibliographic records and materials are available to on-site and interlibrary loan users in a shorter time.

revise technical processing priorities and establish goals for receipt processing, indexing, and cataloging.

ACCOMPLISHMENTS: This activity was begun in FY 1999 but not yet completed. Processing priorities for receiving and cataloging have been revised and implemented. Throughput goals for indexing are in development.

IMPACT/OUTCOME: This activity will be completed in FY 2000.

implement procedures to add in-process serials to the collection immediately upon receipt.

ACCOMPLISHMENTS: A multi-year contract to convert the manual serial records file to machine readable form was issued in September 1999. The inventory of in-process serials were all cataloged or prepared for shelving in the collection. Current serial receipts are now being cataloged and released to the collection within 30 days.

IMPACT/OUTCOME: NAL has decreased the time needed to complete the processing of new serial titles and provided catalog entries with collection locations for over 400 in-process titles. FY 1999 serials cataloging output increased by 100 percent over the previous fiscal year. Timely document delivery and fulfillment of onsite requests are improved by the rapid delivery of books and serials to the collection.

PERFORMANCE GOAL 2.2.3: Expanded provision of Internet and other technology-related training programs for NAL customers.

Indicators:

During FY 1999, *NAL will make training materials available electronically to all of USDA, and implement plans for pilot testing of satellite-based training with some NAL customers. These actions will enable more NAL customers to have access to training.*

ACCOMPLISHMENTS: NAL tested the technical feasibility and identified the issues involved with negotiating agencywide access to electronic resources. In addition, web-based access to licensed resources for the ARS staff were evaluated.

IMPACT/OUTCOME: ARS users will have available from the desktop PC, a selection of relevant agricultural information resources. This will ensure timely on demand access to needed information to support ongoing research.

STRATEGY 2.3: Preservation of significant materials: Preserve significant and important works in agriculture and the fields related to agriculture to ensure availability of NAL's collections to current and future generations.

PERFORMANCE GOAL 2.3.1: Establishment of a national archive for agricultural literature that serves as a centralized storage facility for archival copies prepared by cooperators in the program.

Indicators:

During FY 1999, *NAL will continue to build the national archive for agricultural literature and acquire additional offsite storage space for archival copies prepared by program cooperators.*

ACCOMPLISHMENTS: NAL obtained the master microfilm negatives of the original state and local agriculture projects from the 1980s, for transfer to National Underground Storage (NUS), in Boyers, Pennsylvania, a secure facility with preservation environmental controls. In addition, NAL has obtained the master negatives from phase one of the U.S. Agricultural Information Network (USAIN) preservation microfilming project for transfer to NUS.

IMPACT/OUTCOME: The establishment of this national archive for agricultural information will ensure that significant research information on agriculture is preserved and available for current and future generations of scientists, educators, and producers.

PERFORMANCE GOAL 2.3.2: Development of a program for monitoring quality of electronically archived materials to ensure that the data remain accessible.

Indicators:

During FY 1999, *NAL will begin to implement the action plan for preserving digital USDA publications (pending funding allocation) in collaboration with a steering committee representing mission areas of USDA.*

ACCOMPLISHMENTS: NAL convened a national steering committee representing mission areas of the USDA to begin implementation of the *Framework for Preservation of and Permanent Public Access to USDA Digital Publications*. The committee is overseeing a small scale pilot project to inventory digital publications produced by one USDA agency.

IMPACT/OUTCOME: The implementation of the recommendations in the *Framework for Preservation of and Permanent Public Access to USDA Digital Publications* will have a long-term impact on the availability and distribution of agricultural information to the USDA and the United States citizens. Development of a program for monitoring the quality of electronically archived publications will ensure both preservation and access to important digital USDA publications.

Initiative 3: Creative Leadership: Promote Excellence, Relevance, and Recognition of Agricultural Research through Creative Leadership in Management and Development of Resources, Communications Systems, and Partnerships with Our Customers and Stakeholders.

Analysis of Results: This Initiative focuses on a number of leadership activities/areas that are essential for ARS to maintain the core scientific capability needed to fulfill its mission. Under this Initiative, 17 Indicators are aligned under 24 Performance Goals. Because of the unique and dynamic nature of measuring activities under this Initiative, the Agency was not able to identify specific Indicators for several Performance Goals in FY 1999 and several other Indicators were not successfully completed. In some of these areas, the Agency is rethinking its approach to planning and reporting under certain Performance Goals and Indicators. When this review is completed, its' conclusions will be reflected in the next Annual Performance Plan and Report.

The Report indicates which Performance Goals and Indicators were not accomplished. The progress projected in the remaining Indicators was completed or substantially completed during FY 1999.

STRATEGY 3.1: Develop research agenda: Identify ARS program priorities and core research capabilities and use them to provide leadership in development of the coordinated REE and national research agendas.

PERFORMANCE GOAL 3.1.1: The annual performance plan is delivered on time.

Indicators:

During FY 1999, ARS will meet all REE and Departmental deadlines for submissions required by the strategic plan.

ACCOMPLISHMENTS: ARS' Annual Performance Plan was submitted within the time frames established by USDA and REE.

IMPACT/OUTCOME: ARS' Annual Performance Plan was submitted to Congress as part of the total Departmental performance plan. REE did not develop a coordinated research agenda in FY 1999.

PERFORMANCE GOAL 3.1.2: Meet REE deadlines for submission of material for inclusion in the Coordinated Research Agenda.

Indicators:

During FY 1999, ARS will meet REE deadlines for submission of materials related to the Coordinated Research Agenda.

REE did not develop a coordinated research agenda in FY 1999.

PERFORMANCE GOAL 3.1.3: Annual conferences of public and private individuals are convened to discuss major researchable issues in agriculture and to articulate approaches to addressing these problems.

Indicators:

During FY 1999, ARS will select the researchable aspects of a high priority national issue that will benefit from a broad public/private, Federal/State/local dialogue and convene an appropriate conference.

ARS has recently aggregated its 1,100+ research projects into 23 National Programs. The full implementation of these programs will take several years. Instead of a single national conference, ARS decided to concentrate its efforts in FY 1999 on a series of National Program Workshops (some cover an entire National Program and others address program components). Approximately 25 National Program Workshops were held during FY 1999. The workshops generated synergistic interactions between customers, stakeholders, and ARS scientists that will help to determine the research agenda and ensure the relevancy of the Agency's research program.

PERFORMANCE GOAL 3.1.4: Rapid responses to crises.

Indicators:

During FY 1999, ARS will respond to threats to the security of American agriculture and to the safety of the Nation's food supply.

ACCOMPLISHMENTS: Fusarium Head Blight (FHB) (scab) of wheat and barley has caused devastating yield losses (more than \$3 billion since 1993) and resulted in lower quality grain because of the presence of a fungus-produced mycotoxin. In the last three years ARS funding for research on FHB has increased dramatically from \$200,000 to \$5,800,000 annually. A large research program involving ARS and university scientists has been established to deal with the FHB problem. Goals are the generation of FHB-resistant varieties and the development of integrated disease control strategies.

IMPACT/OUTCOME: Through a comprehensive, coordinated research program solutions to the scab problem are expected within a few years. Without this program, solving the scab problem would have been substantially delayed.

STRATEGY 3.2: Civil Rights: ARS is committed to the principal of Civil Rights and the implementation of the Civil Rights Action Team Report. The ARS Civil Rights Staff (CRS) recognizes that systematic communication is important as a means of ensuring that its services meet the expectations and needs of its customers/stakeholders, including managers, supervisors, and employees.

PERFORMANCE GOAL 3.2.1: Written policies and guidance to facilitate implementation of the Civil Rights program.

Indicators:

During FY 1999, ARS will develop a series of topical brochures and fact sheets to provide specific EEO/Civil Rights program information to ARS managers, supervisors, employees, EEO Advisory Committees, students, universities, and others. Topics will include student programs, special emphasis programs, and the role of EEO Advisory Committees. These are needed so that managers and employees are better informed and students and universities will have increased awareness of opportunities.

ACCOMPLISHMENTS: Two topical brochures have been developed on the informal and formal EEO Complaints Program. The brochures are currently being reviewed by the ARS Information Staff. The Counseling Fact Sheet was distributed to management and is available to all employees via the ARS EEO/CR Website.

IMPACT/OUTCOME: ARS managers, supervisors, and employees will be better informed.

PERFORMANCE GOAL 3.2.2: Improve all aspects of the Title VII program which includes EEO training, data collection, and monitoring and evaluation.

Indicators:

During FY 1999, ARS will

develop and implement a system to monitor and evaluate the EEO program by conducting onsite EEO program evaluations. The system is needed to determine the extent to which ARS is complying with equal employment opportunity requirements.

ACCOMPLISHMENTS: The indicator has not been completed but it will be completed in FY 2000. ARS has contracted with an 8(a) firm to conduct an Agencywide on-site EEO compliance review during FY 2000.

IMPACT/OUTCOME: The compliance review will provide a systematic method for obtaining information and feedback from and to ARS managers, supervisors, and staff. If appropriate, ARS will take corrective action.

develop and implement a system to routinely collect data of all employment related activities. The system is needed to analyze and monitor data; develop reports showing trends, patterns, accomplishments, and needs; and develop recommendations for improvement.

ACCOMPLISHMENTS: ARS has contracted with a firm to develop the database which will provide all information regarding employment-related activities and it will provide a mechanism for analysis.

IMPACT/OUTCOME: ARS will effectively utilize agency resources and will provide accurate reports to management on an as-needed basis.

STRATEGY 3.3: Additional funding: Encourage acquisition of additional funding to improve ARS programs and priorities.

PERFORMANCE GOAL 3.3.1: Partnerships are established.

PERFORMANCE GOAL 3.3.2: Procedures are implemented.

PERFORMANCE GOAL 3.3.3: Outside support increases.

Indicators:

During FY 1999, ARS will meet or exceed the targets set for securing additional funding.

ARS is rethinking this Performance Goal and Indicator. As presently configured the approach is not meeting the Agency's needs. If a more useful approach can be determined, reporting will begin in FY 2001.

STRATEGY 3.4: Customer service: Improve customer service.

PERFORMANCE GOAL 3.4.1: Improved customer satisfaction.

Indicators:

During FY 1999, ARS will establish targets for expanding customer input and improving customer satisfaction.

ACCOMPLISHMENT: As part of the process of implementing the new National Programs, ARS held approximately 25 National Program Workshops during FY 1999. These sessions brought together a wide range of customers, stakeholders, partners and ARS scientists and managers to discuss the future directions of research in each programmatic area. Evaluation forms were used at each workshop which reflected a high level of customer/stakeholder satisfaction.

IMPACT: The National Program Workshops have expanded and formalized the interaction between ARS and its customers and stakeholders. This interaction increases mutual understanding and helps ensure that the scientific work of the Agency is relevant to the needs of American agriculture and related industries.

PERFORMANCE GOAL 3.4.2: Customer needs are identified.

Reporting will begin in FY 1999.

STRATEGY 3.5: Management of facilities: Provide appropriately equipped Federal facilities required to support the research and information activities of ARS into the next century.

PERFORMANCE GOAL 3.5.1: Criteria and priorities identified.

Indicators:

During FY 1999, ARS will update annually the ARS facilities modernization plan which identifies ongoing repair and maintenance needs of existing Agency laboratory and support facilities.

ACCOMPLISHMENTS: ARS implemented Congressionally directed new construction and facilities modernization and repair and maintenance programs.

IMPACT/OUTCOME: The Agency implemented priority construction, modernization, and repair and maintenance needs.

ACCOMPLISHMENTS: Updated the 10 Year Facilities Plan which identified future projects or needs in terms of repair and maintenance/modernization, new construction, energy retrofit, accessibility, hazardous waste clean up, and building disposal/demolition needs from FY 2000 to FY 2009.

Implemented Congressionally directed new construction and facilities modernization at priority locations.

Implemented repair and maintenance programs at 38 locations. Some of the types of projects include repairs or upgrades to roofs, building systems, sewage systems, roads, greenhouses, fencing, accessibility projects, Y2K upgrades, and fire alarm systems.

IMPACT/OUTCOME: ARS scientists have available state of the art facilities to conduct research. In addition, the employee work environment meets safety and health requirements, as well as the President's energy conservation goals.

STRATEGY 3.6: Maintenance of core research capabilities: Develop and implement comprehensive human resource systems and policies to support and enhance ARS' core research capabilities while maintaining the flexibility to shift research and form interdisciplinary teams to address emerging problems.

PERFORMANCE GOAL 3.6.1: Identify core capability requirements and develop a scientific staff to meet long-term research needs.

Indicators:

During FY 1999, *ARS will increase its core capability by significantly increasing the number of research scientist positions (SYs).*

ACCOMPLISHMENTS: Continued the Consolidated SY Recruitment strategy which included:

Establishing a three cycle annual schedule for the simultaneous announcement of all vacant SY positions.

Continued placement of paid ads in *Science* and other appropriate professional journals.

Posting all vacancy announcements on ARS' home page, the Office of Personnel Management's electronic bulletin board, and other bulletin boards as appropriate.

Hiring 127 scientists in FY 1999. The core SY workforce showed a net increase of 51; another 50 SYs have been selected, with entry on duty dates set for FY 2000.

Publishing seven new human resource management policy and procedural issuances including one on the Research Position Evaluation System (RPES).

Publishing seven additional Policies and Procedures issuances as part of the ARS human resources management program in support of REE's research mission, including one governing receipt of Foreign Gifts and Decorations (P&P 468.4), which particularly affects senior research scientists who have achieved international stature and recognition. The Research Position Evaluation System (RPES) P&P and Manual were also revised and published.

Conducting four ARS Area Office orientation sessions for new research scientists.

Conducting six new scientist orientation sessions for newly hired research scientists. They were introduced to ARS and Area management philosophy and expectations, including the administrative requirements and procedures needed to be successful.

IMPACT/OUTCOME: ARS has implemented an aggressive strategy to ensure the quality of its scientific workforce and has reestablished the Agency's competitive recruitment position in the scientific community. ARS has increased its core research capability by a net of 51 scientific research positions.

PERFORMANCE GOAL 3.6.2: Establish a database of ARS experts by discipline and research areas of expertise.

ARS reevaluated this approach and decided not to develop this database at this time.

PERFORMANCE GOAL 3.6.3: Train 1,300 postdoctoral students, and competitively select 10 percent of them to fill full time positions.

Indicators:

During FY 1999, ARS will

continue to train Research Associates and at least 260 postdocs each year, and competitively select 10 percent of them as full time Agency employees. As the number of full time scientists increases, the number of postdocs hired can be expected to decrease each year.

ACCOMPLISHMENTS: ARS had 261 postdocs on the rolls; 37 have been placed into permanent research scientist positions.

IMPACT/OUTCOME: These accomplishments exceed the goals of 260 postdocs on board and conversion of 10 percent of them into full time SYs.

STRATEGY 3.7: Provide administrative support to REE: Serve as the lead agency in providing administrative and financial management services for Research, Education, and Economics.

PERFORMANCE GOAL 3.7.1: Customer participation in planning processes.

Indicators:

During FY 1999, ARS will review customer needs concerning the AFM Strategic Plan.

ACCOMPLISHMENTS: Contacted customers, employees and stakeholders for input on emerging issues, changes needed in AFM program emphasis, and recommendations for improving AFM processes and service delivery. Nearly 200 responses were received.

IMPACT/OUTCOME: Customer participation in the AFM strategic planning process resulted in customer core service needs being identified, prioritized, and addressed in the goals and objectives of the revised AFM Strategic Plan dated March 1999.

ARS reviewed customer needs regarding the ARS Strategic Plan. Customer input served as the basis for refinement of the AFM Strategic Plan.

ACCOMPLISHMENTS: AFM published detailed information on plans to carry out strategic objectives on its website. AFM routinely collected feedback on customer needs and priorities and used this information to make minor adjustments in the plan. AFM also began designing more formal mechanisms to collect and analyze information from customers on the adequacy, timeliness, and quality of services.

IMPACT/OUTCOME: Customer needs were identified and included in the AFM Strategic Plan.

PERFORMANCE GOAL 3.7.2: Strategic Plan is developed and communicated to REE customers.

Indicators:

During FY 1999, ARS will revise the AFM Strategic Plan and make it available to customers, employees, and stakeholders.

ACCOMPLISHMENTS: A revised Strategic Plan was developed and placed on the AFM home page for review and reference by customers, employees, and stakeholders.

IMPACT/OUTCOME: The AFM Strategic Plan addressing customer service requirements was issued in April.

During FY 1999, AFM will circulate the revised Strategic Plan to its REE customers.

ACCOMPLISHMENTS: The Strategic Plan was revised and circulated.

IMPACT/OUTCOME: AFM services continue to be provided consistent with customer need as identified in the Strategic Plan.

STRATEGY 3.8: Program excellence and relevance: Ensure excellence and relevance of ARS programs through a variety of comprehensive reviews.

PERFORMANCE GOAL 3.8.1: Internal and external peer reviews are conducted on all research projects before implementation.

Reporting will begin in FY 2000.

PERFORMANCE GOAL 3.8.2: Review of the productivity, quality, and impact of individual scientists as scheduled in the Research Position Evaluation System (RPES).

Indicators:

During FY 1999, ARS will conduct approximately 350 RPES reviews of research scientists each year.

ACCOMPLISHMENTS: ARS staff conducted 412 RPES reviews with the following results:

180	Promotions
224	Remains-in-Grade
1	Insufficient Factual Basis
7	Grade/Category Problems

Based on USDA/OPM instructions, demotions as an RPES panel option were discontinued several years ago. If a case is scored below grade, management has the responsibility to work with the scientist to improve performance in the position over a specified period of time. If improvement does not occur so that the position can be properly classified at least at the current grade level, then the scientist is either reassigned to a vacant non-SY position or is removed from the Federal service.

IMPACT/OUTCOME: ARS maintains a high quality scientific research workforce that is able to respond to the critical needs of American agriculture, as shown by the productivity, quality, and impact of the scientists' accomplishments.

PERFORMANCE GOAL 3.8.3: Program reviews are conducted periodically, and programs are sustained or redirected as appropriate.

Reporting will begin in FY 2000.

STRATEGY 3.9: Improve financial management: ARS/Administrative and Financial Management will support Departmental efforts to improve financial management.

PERFORMANCE GOAL 3.9.1: Implement integrated management systems in USDA.

Reporting will begin upon issuance of Departmental evidence on the Foundation for Financial Information System (FFIS) for mandatory use by USDA Agencies.

ACCOMPLISHMENTS: ARS convened a REE Foundation Financial Information System (FFIS) preimplementation team. The USDA Risk Management Agency in Kansas City, Missouri, was visited to learn about its strategy, experiences, and "pros and cons" with the implementation of FFIS. Several preplanning sessions with the Office of Chief Financial Officer (OCFO) Project Office Staff were conducted to become better acquainted with the FFIS product. A planning package was developed with recommended corporate strategy, issues, actions and options for REE senior management decisions to begin implementing the FFIS system and associated applications.

IMPACT/OUTCOME: ARS, on behalf of REE, will use a conservative implementation approach that permits the fund holders to maintain stewardship and reporting control over the status of funding sources, assets, obligations, and expenditures. This approach will afford REE agencies sufficient budgetary and proprietary accounting controls, and time to test the new FFIS accounting system to contain and fix any problems that may occur early on.

PERFORMANCE GOAL 3.9.2: Correct in a timely manner internal control deficiencies.

Reporting will begin upon issuance of Departmental evidence on the FFIS for mandatory use by USDA agencies.

During FY 1999, ARS will continue compliance with the Federal Managers' Financial Integrity Act (FMFIA), including timely completion of audit report recommendations and the timely correction of any FMFIA weaknesses that are identified.

ACCOMPLISHMENTS: No material weaknesses were identified in program reviews and/or evaluations conducted by staffs. Neither the GAO, the OIG, nor other external audit organizations disclosed any findings of material weaknesses during FY 1999.

IMPACT/OUTCOME: ARS' 1999 evaluations indicated that the systems for internal accounting and administrative control provided reasonable assurance that control objectives were achieved.

PERFORMANCE GOAL 3.9.3: Make available reliable cost accounting information.

Indicators:

During FY 1999, ARS will continue to work with the OCFO and the National Finance Center (NFC) to implement USDA cost accounting standards on behalf of all REE agencies, and perform biennial reviews

of user charges as required by OMB Circular A-25. ARS will also continue to review Agency operations to identify new potential user fee situations.

ACCOMPLISHMENTS: Complete cost accounting applications and reporting will not be accomplished until the implementation of FFIS. The design of FFIS will allow REE to capture cost accounting information for its programs according to Federal accounting standards.

REE has conducted a biennial review of fees and other charges and reported the information in a OCFO data call. In addition, an evaluation was made of potential user fee (things of value) situations that should be reported, but none were found.

Published Bulletin 99-250, "Collection and Use of Fees for Revocable Permits and Easements," that provides guidance and instructions for the collections and use of fees for revocable permits, easements, or other special use authorizations for the occupancy or use of land and facilities under agency custody and control.

IMPACT/OUTCOME: No potential new activities or situations were identified relating to user fee requirements other than the information reported in the biennial review. Collections of fees for revocable permits and easements were returned to agency programs.

<p>PERFORMANCE GOAL 3.9.4: Clean and timely audit opinions are provided on audited financial statements.</p>

Indicators:

Reporting will begin upon issuance of Departmental evidence on the FFIS for mandatory use by USDA agencies.

During FY 1999, ARS will prepare, review, and certify the yearly consolidated financial statements of the REE agencies as required under the Chief Financial Officer's Act.

ACCOMPLISHMENTS: ARS responded to all requests from OIG for financial information, and arranged for site visits by auditors to gather information in order to render opinions on audited financial statements.

IMPACT/OUTCOME: ARS is awaiting response from OIG on FY 1999 audited financial statements.